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LIGHT VERSUS ACTIVITY IN THE REGULATION OF THE SEXUAL CYCLES OF BIRDS: THE ROLE OF THE HYPOTHALAMUS

By ALBERT WOLFSON

INTRODUCTION

The desire to induce migration of birds experimentally incited Rowan to devise a method whereby he could stimulate the development of the gonads, for he believed that if birds were liberated in the winter period with recrudescing gonads they might migrate north on release. Through artificial illumination from ordinary electric light bulbs, juncos were subjected to increasing day lengths, and in spite of extremely low temperatures the gonads developed, some testes almost reaching maximum size. Consequently Rowan undertook a number of experiments in bird migration. These have been critically examined and discussed elsewhere (Wolfson, 1940). In addition, he performed an experiment to determine whether exercise could replace light as the stimulating factor. From the results he concluded that light was important only in so far as it enabled the birds to exercise, and that the daily increase of activity was the factor which induced gonadal growth.

Since Rowan's initial work there has been much experimentation. The effect of light upon the gonads has been confirmed by the manipulation of the sexual cycles of many species of birds and of other vertebrates. Corroborative data for Rowan's "exercise theory," however, have not appeared. Instead, the work of Benoit, Bissonnette, Riley, and others has led to the conclusion that light itself, *qua* light, is the real factor involved and not activity.

Although numerous experiments have been performed to determine which theory is correct, the problem is still basically unsolved, and the available data are contradictory and confusing. It is the purpose of this report to attempt an elucidation of the problem by critically examining and discussing the evidence offered in support of each theory and by presenting a new interpretation of the valid evidence.

PRESENT STATUS OF THE PROBLEM

Rowan bases his theory on the results of two experiments and on his investigation of the sexual cycles of London and "country" starlings. The experiments involved the substitution of "compulsory exercise" for the daily increments of illumination. The apparatus consisted of two moving bars which swept all possible perches in the experimental cage every 20 seconds. It was necessary to conduct the experiments in a room with feeble light to enable the experimental birds to see the bars. The first experiment began on March 17 and ended April 28. The number of birds used was small: 6 experimentals, only 4 of which gave valid results, and 3 controls. The results are given below (measurement is average length of the two testes):

- Experimentals
1. Mar. 25 — 1.2 mm.
 2. Apr. 9 — 1.5 mm.
 3. Apr. 12 — 1.6 mm.
 4. Apr. 28 — 3.4 mm.

- Controls
1. Apr. 3 — 1.0 mm.
 2. Apr. 11 — 1.0 mm.
 3. Apr. 28 — 1.3 mm.

Rowan concluded from these results (1929: 202) "that the light increases . . . afford the birds the opportunity of increasing exercise, and that this is the crucial factor in inducing the development of the gonads."

The validity of Rowan's conclusion has been doubted because the gonads had already begun to recrudescence before the experiment was undertaken. Another objection is that the birds were on a 13.5-hour day and had been subjected to normal spring increases of day length before they were placed on a basic 9-hour day at the beginning of the experiment. It is known that such a sudden reduction in day length has an inhibitory effect on the normal gonadal cycle. After four weeks of exercise treatment, when the day length for the experimentals had reached 13 hours, the gonadal growth was slight. Two weeks later, the day length having been maintained constantly at 13 hours, one sample showed a marked development. The testis sizes of all the experimental samples, however, can be found in wild birds on similar dates. This is shown by Rowan's graph of the gonadal cycles of wild juncos (1929, pl. 32), and by data which I have collected. Juncos that were retained at Berkeley showed lengths of testes (average of the two) between 3.3 and 5.7 mm. on April 28. It seems, therefore, that the increased daily activity did not induce gonadal growth, but merely permitted an approximately normal rate of growth to continue in spite of the inhibitory effect of the reduction to a basic 9-hour day length.

Rowan repeated the experiment in 1937 to invalidate the objection that the experiment occurred at too late a date (Rowan, 1937). The technique was similar, but the experiment was begun on January 4 and terminated on February 28. The lighting schedule was altered so that all the birds were on a basic day of 7 hours for the first week, and 8 hours for the remaining seven weeks. The day length of the experimentals on February 28 was 14 hours, 8 hours of normal daylight and 6 of enforced activity. The results are not as striking as in the previous experiment, in spite of the eight weeks of treatment as compared with six previously, but recrudescence, little as it was, occurred in the experimentals, whereas the control showed no response. Only a small number of birds was available, for they were shipped to England where the experiment was performed and there was a high mortality in transit. The number used is not stated, nor are measurements of the testes given, but from the photograph of the testes, it seems that there were three experimentals and one control. The maximum size reached by the experimentals, as calculated from the illustration, did not exceed 1.4 mm. in length.

The original objection of a late start was overcome by beginning this experiment on January 4 when the gonads were at winter minimum, but again the objection arises that the gonadal growth exhibited by the experimentals did not exceed that of wild birds. The testes of wild juncos collected at Berkeley at the end of February show an average length of from 1.0 mm. to 1.5 mm. This argument may seem extraneous if one feels that since the control showed no development, the development in the experimentals was induced by the enforced wakefulness. But it must be remembered that the control was on a basic 8-hour day, a reduction from the normal day lengths of spring, and that any possible recrudescence which would have occurred normally was *actively inhibited* by this short constant day length. The experimentals, although reduced to this short day length, were given daily increments of enforced activity and this treatment may not have activated gonadal development but merely *prevented the inhibition* of the normal gonadal cycle. The inhibitory effect was well demonstrated by the controls. When compared to birds on a light schedule the development was extremely slow. On this point Rowan writes (1938a:384): "The augmented rate so characteristic of light stimulated examples at about the 8th week did not materialize. Only a single bird was available on the last day. A conclusive statement cannot be based on one measurement."

I believe that Rowan, in the above two experiments, has given no evidence that substituting enforced wakefulness for light will induce gonadal development. He demon-

strated, however, that juncos placed on a short basic day after December 21 showed little or no gonadal development, and that enforced wakefulness when substituted for light permitted approximately normal gonadal growth in spite of the inhibitory effect of the short basic day on which the birds were placed. To be certain that enforced wakefulness could induce gonadal growth, experiments should be conducted in November and December. The controls would then receive no experimental reductions in day lengths and a response in the gonads of the experimentals could not be explained by the continuation of the normal cycle. The experimental procedure would be the only possible explanation for any recrudescence which occurred.

In a short note published in the addendum to his recent article, Rowan (1938a:402) states that English Sparrows "and juncos were subjected to increasing periods of mechanically induced wakefulness in total darkness for four weeks, following a preliminary training period of two weeks in a faint and continuously diminishing glow. The sparrows attained virtually full breeding condition while the juncos were highly developed. . . . These determinations rest wholly on the macroscopic evidence." To my knowledge the details of this experiment have not yet been published, and since we do not know when the experiment was conducted or how well it was controlled, it is not expedient to analyze the results critically at this time.

After the completion of these experiments Rowan (1937, 1938b) obtained data on the gonadal cycles of starlings in England to support his theory. He observed that London starlings roosting in feeble light, but receiving constant disturbance from traffic, were maintained in a state of wakefulness more or less continuously until the theatre crowds had gone home, sometime after midnight. This situation apparently was a natural experiment in enforced wakefulness. Examination of the gonads of London starlings in contrast to country starlings revealed that the birds in London showed a precocious development of the gonads in early February. They were approximately two months in advance of the country starlings. To explain these observations Rowan writes (1938b: 69): "There appear to be three environmental factors . . . that might be instrumental in inducing precocity in London starlings:—(a) Higher temperatures than at country roosts. (b) The additional light provided by the street lamps in whose rays the birds sleep. (c) An increased day length imposed on them by traffic disturbances. Or the effects might be induced by a combination of two or all of these." After examining these three factors he suggests (p. 75) that "the additional period of wakefulness imposed nightly on the London as against country starlings must be looked upon as the crucial element in inducing premature development of the gonads during the winter months." In this same publication Rowan considers the possibility that the observed differences might be due to racial factors (p. 68):

The early residents of August and September appear to be certainly natives. Starlings from abroad, chiefly from the shores of the Baltic and the German Ocean reach England in October and November, as has been shown by ringing, while birds ringed in England in winter have frequently been recovered from breeding grounds abroad in summer. . . . The point of possible importance is whether the foreigners wintering in England are normally in a different stage of sexual development in mid-February from British-bred birds; and if the London birds are all natives and the country residents all foreigners (or vice versa), could such a distinction account for the observed differences?

It seems to me that the answer is certainly in the negative. Bissonnette's investigations have shown that this species responds so easily and quickly to the conditioning of the gonads under experimental manipulation that it seems wholly improbable that foreign and native birds, living under the identical weather and food and daylight conditions of England, could vary to such an extent in their sexual development. They are not even subspecifically separable, and cannot be distinguished from each other in the hand.

As improbable as it may seem, it is now an established fact that migrants and residents of the same species of bird wintering in the same locality do show different sexual

cycles, those of the residents being approximately two months ahead of the migrants, as was observed in the starling. This has been shown for the Oregon Junco (*Junco oreganus*) by Wolfson (1940) and for the White-crowned Sparrow (*Zonotrichia leucophrys*) by Blanchard (MS). With the knowledge that such a condition exists in these birds, Rowan probably would agree that racial differences can explain the differing gonadal cycles of starlings wintering in Britain. Many resident and migrant individuals of the Oregon Junco and White-crowned Sparrow cannot be distinguished in the hand, but after careful study and comparison with series of skins, they can be separated in most instances. A careful study of European starlings would probably reveal the existence of external differences in resident and migrant populations. If these populations have existed separately for a great length of time, and if no large amount of hybridization has occurred, morphological differences should be in evidence today.

The recent work of Bullough and Carrick (1939) seems to leave no doubt, at least not in my mind, that there are two races of wintering starlings in England, one resident and one migratory, the former with an earlier breeding cycle. Resident starlings collected between March 11 and March 21 from a quiet residential district two miles from the center of Leeds, where they were roosting under eaves and where there was no increase in numbers in winter after the migrants arrived, had testes that were mature with the seminal vesicles containing spermatozoa. These birds were not subjected to traffic disturbances, yet their gonads were equivalent to those of London Starlings. Starlings were also obtained between March 7 and March 14 from a roost which had been established in the previous autumn. These birds were mostly of continental origin and similar to Rowan's country starlings. In 15 males the testes were small and dark gray in color. One male, however, was entirely different. The testes were almost fully mature. Although obtained in the country, this bird was in the same condition as those collected near Leeds. It appeared therefore that a number of resident starlings were present among the thousands of migrants occupying the roost. This was confirmed when all the continental birds left on March 15 and a population of about 1000 starlings remained. Between March 22 and March 25 seven males collected from this population showed testes similar to those of the male collected on March 9. These birds were clearly local and it was determined that they came from a small area of some five square miles immediately adjacent to the roost.

Rowan should have collected resident birds from a locality where they were not disturbed at night. All of his country samples unfortunately were migrants.

It is to be regretted that Bullough and Carrick do not mention the fat condition of the migrants collected between March 7 and March 14. The migrants left the roost on March 15, and according to our studies at Berkeley, migratory individuals show a heavy fat deposition prior to departure. The residents show no such fat deposition in the spring.

This new information about starlings should be of great interest to American ornithologists, for the starlings introduced on this continent have shown definite signs of splitting into resident and migratory populations. It would be valuable to collect a series of gonads from two such different populations to determine whether comparable differences can be found.

Because of the defects of Rowan's experiments and because it has been conclusively shown that the sexual precocity of London starlings is not due to wakefulness but to racial characters, it is clear that Rowan's activity theory is at present not well supported.

Bissonnette (1931) repeated Rowan's activity experiment, but was unable to corroborate his results. Upon study of his technique, however, I feel that the experiments are not comparable, and that it can reasonably be questioned if Bissonnette's "work" experiments demonstrated that increasing periods of wakefulness in birds cannot be a factor in inducing gonadal development. Bissonnette used the starling for his experi-

ments, and the individuals, according to him, were residents. The juncos used by Rowan were migrants. This is an important distinction, for Wolfson (*loc. cit.*) and Blanchard (*loc. cit.*) have shown that resident and migratory races of the same species differ distinctly in their physiological response to identical environmental conditions. Even disregarding this fact, other objections can be raised to Bissonnette's work. The irregularity of the daily increment of muscular exercise was marked. The belt in the "work" cage caught for short periods and its release was delayed on many occasions. "Times from three hours onward were variable as shown by the graph . . . but there was a general increase in time of experimental treatment up to between six and seven and a half hours per night and none thereafter, with the exceptions due to accidents and shown in the graph" (p. 288). He argues that "these vagaries are not believed to be very significant because the amounts of light to which birds are subject in nature vary from day to day as a result of atmospheric conditions," but it is not probable that they would experience the differences to which they were subjected in this experiment. It is most certainly true that they would not show the abnormal behavior of the birds in the work cage. Of their behavior Bissonnette writes (p. 288):

It was soon noted that the birds in the "work" cage, instead of trying to remain on the roost to be forced off by the cross-strip on its circuits, after one or two experiences with the strip, flew up and hung braced by their tails and claws from the wires of the sides and the end of the cage nearest the light, and only occasionally, when fatigued, sought rest on the roost, to be started off again in less than twenty seconds. They did learn to step over it a few times when tired, but seemed to prefer to hang from the wire most of the time when the machine was going. When it stopped, they soon came to rest on the roost. In none of the cages did they roost on the floor. Birds in the "light" and "inside control" cages did not behave in this way.

Can one rely on the results of such experiments when the behavior of the subjects is so abnormal? Bissonnette dismisses the behavior of the birds as being of any significance by stating (p. 289):

That the enforced work did not interfere with the general health of the birds subjected to it is shown by the fact that during the whole experiment from December 4th to May 11th only one bird was found dead in that cage, and he had been caught by the cross-strip at one end of the roost and wedged in against the end of the cage, at the place of exit of the belts, and killed by constant pressure on his body. The fact that he did not fall to the floor of the cage is evident [sic] he did not die from disease or starvation, but was caught and held.

Must a factor in an experiment cause the death of the subject before it can be considered important in altering the results?

Even if one dismisses the objections raised above, as Bissonnette does, and considers his results valid, there is still reasonable doubt about his conclusion that light *per se*, and not wakefulness, is the factor which induces gonadal development. Bissonnette's experiments were conducted from December 4 to May 11 and, with the exception of one male, all males were worked during a period when the gonads were recrudescing. In addition, all birds were subjected to normal day lengths until March 19 when the day length was 12 hours. From March 19 to May 11 a constant day length of 10 hours was maintained by shuttering the room from 5 p.m. to 7 a.m. Because of these lighting conditions and because the gonads had already begun to recrudescence, it is impossible to determine from these experiments whether or not daily increases in the periods of wakefulness can induce gonadal growth. Is Bissonnette justified, therefore, in concluding that added exercise periods without light are not effective in inducing gonadal activity in the starling?

The enforced wakefulness, as in Rowan's experiments, did modify gonadal activity. On March 19 two newly captured starlings with enlarged gonads, one male and one female, were placed in the work cage. They received 10 hours of daylight, a reduction of two hours from normal day length, plus 6 to 6½ hours of work each day until April 15

when they were autopsied. The gonads of the worked birds were larger than those of the "inside controls" whose "light history" had been the same and whose gonads had undergone some regression as a result of the reduction to a constant 10-hour day length. Bissonnette concluded (1931:298) that "they had either continued to increase in size and activity after the 'inside controls' started to regress, or else had been slower than they in regression. In either case they lag behind the inside controls as a result of more daily exercise." This signifies that the exercise prevented gonadal regression.

Two birds that were worked from January 15 to April 15 had testes that were "medium" and "enlarged considerably" (p. 290) and were not greatly different from those of birds worked only from March 19 to April 15. The testes of the control were small as a result of regression. These results lead me to the conclusion that enforced exercise, or wakefulness, permitted a subnormal rate of gonadal growth and prevented regression in spite of the reduction in day length.

The differing gonadal cycles of migrant and resident starlings may prove to be of great significance in future work with starlings in this country. Although a species may be "resident" in a locality, the individuals may be migratory. Whether this has been a complicating factor in Bissonnette's experiments is difficult to say. Future work on this point is certainly necessary.

Riley (1940) has performed experiments somewhat similar to those of Rowan and Bissonnette in that a mechanical activator was employed. Riley's induced activity, however, occurred in complete darkness in a revolving drum. The subject was the English Sparrow, and the individuals were probably residents. His results showed that activity in complete darkness did not affect the gonads, but that if light was present in the activity chamber the gonadal response was similar to that of birds on a lighting schedule alone. He concludes that there is little doubt about the importance of light itself in regulating the sexual activity of the sparrow. He thinks that the positive results obtained by Rowan in his activity experiment may be explained by the fact that light and activity were not completely separated. The experimental birds which were awake could perceive the feeble light, while the controls which were asleep "with closed eyelids and heads tucked under their back feathers were subject to none of this additional lighting" (p. 82). Although Bissonnette's activity experiments were conducted in feeble light, some of his birds failed to show any appreciable gonadal response. Riley (p. 88) explains this by suggesting that "starlings may require higher intensities of light than the junco, or as already suggested by Rowan, negative reactions may be the result of unfavorable excitation of the birds."

In connection with Riley's work a significant objection arises. His birds were not trained in the activating mechanism during the day, as were Rowan's juncos. This point was not stressed by Rowan, or other authors who have reviewed his work.

The juncos were trained in the apparatus during the day apparently for some time before the start of the experiment. In his original report on the experiment (Rowan, 1928:11) he remarks: "After the birds were deemed to have got accustomed to the device a second transverse bar was attached at the opposite point of the belt. As they soon developed a system of merely hopping over it, the exercise could scarcely be described as strenuous." He implies that they were trained in the daytime, because at the onset of the experiment both bars were apparently on the belt. No explicit statement of this matter is made, however, until a later publication (Rowan, 1931:125).

This factor, I believe, is of the utmost importance, for if the state of wakefulness of the birds is conditioned to the stimulus provided by the apparatus, then one can be reasonably sure that the experimentally added wakefulness is definitely linked to the nervous system. It is difficult to believe that birds revolved in small cages within a dark chamber, in which they had not been before in the light, could undergo a normal state

of wakefulness. Riley himself remarks (p. 83): "In the revolving activator lighted, it could be observed that some of the birds were more excited than is customary in light experiments." If they were abnormally excited in the light when they could see where to move as the drum rotated, it is difficult to believe that they were not more excited in the dark as their bodies were forced to move. There is no doubt that the birds were not asleep, but I think it is questionable whether they underwent a normal state of wakefulness in the activator.

The above experiments in birds are the only ones to my knowledge that have attempted directly to substitute wakefulness for light as a means of activating the gonads. In each case it has been shown that no conclusive evidence has been presented to prove that light itself is the stimulating factor, or that wakefulness is the stimulating factor. Other types of experiments, however, have been done which have yielded important information relative to the problem.

The experiments of Benoit on ducks (1937) have shown that light cannot affect the gonads in hypophysectomized birds. *A priori* one would expect this to be true, for the anterior lobe of the pituitary produces the gonadotropic hormones, and without these the gonads cannot develop. Realizing the indispensability of the pituitary in the light reaction, most authors think that the light stimulates the pituitary to secrete the gonadotropic hormones which in turn stimulate gonadal development. That this is true cannot be doubted, but the original problem still remains. The pituitary is essential, but by what means does the light affect the pituitary?

Rowan naturally believes that the stimulus is the state of wakefulness, but he offers no precise explanation of how the state of wakefulness can induce the gonadotropic activity of the pituitary. This weakens his theory considerably. He writes (1938b:73): "Little seems to be known of the physiological changes induced by altering the relation of waking to sleeping hours, yet . . . the accumulated experimental evidence as it now stands, in spite of many apparent contradictions, does not preclude the possibility that it is such changes—little as we know about them—that are primarily instrumental in the activation of the pituitary and gonads." His argument is certainly valid, and, as will be shown later, it probably has not received an accurate evaluation.

Benoit, Bissonnette, and others adopt the view that the light affects the anterior lobe of the pituitary through a receptor and that light itself is the important factor. The receptor immediately investigated was the eye, and the results of various investigations have been inconclusive. Other receptors have been suggested such as the skin, and the region of the head around the eye, but again, even considering the quantity of the work which has been done, especially by Benoit, the results have not led to explicit and decisive conclusions.

DISCUSSION AND CONCLUSIONS

After a careful study of both sides of the problem, and the recent work in related fields, it seems to me that there is an explanation which could embrace both the light and activity theories and nullify the present controversy. This explanation is not based on incontrovertible facts, but in the light of our present knowledge it seems to be more than just a possibility. I think it should be taken into consideration in future experiments, as well as in our search for the factors which regulate the sexual cycles of birds under natural conditions, for in these ways alone can it be tested and its value determined.

When the gonads of birds, whose sexual cycles can be manipulated by light or activity experiments, are recrudescing, whether they are under experimental conditions or under natural conditions, the amount of time spent in activity, or wakefulness, is increasing daily, and conversely, the amount of sleep is decreasing. As a result of the work of Kleitman (1929) there is little doubt among physiologists that the cycle of sleeping and waking is controlled by the central nervous system. Kleitman's well accepted theory of sleep,

briefly stated, is that due to fatigue, habit, etc., the subject will relax its muscles, close its eyes, and in other ways decrease afferent impulses to higher centers; this abolishes motor activity due to increased synaptic resistance in the higher centers so that sub-threshold impulses are not critically analyzed. Impulses arising out of primitive processes and reactions such as hunger, thirst, and muscular movement cause awakening, but the ability to keep awake throughout the day is dependent, on the other hand, upon the development of conditioned reflexes. As long as the impulses from the different distance receptors can be analyzed by the cortex the state of wakefulness will be maintained. If the stimuli are not received from the periphery or cannot be analyzed by the cortex the subject is unable to remain awake. The state of wakefulness is, therefore, an acquired phenomenon and not inborn. Infants and very young animals do not show it.

Although Kleitman's work was well received, it remained for Ranson (1939) and Ranson and Magoun (1939) to develop the theory and put it on a neuro-anatomical basis. The problem had been the localization of the areas involved. On the basis of their recent work, it is clear that the hypothalamus plays an important rôle in sleep regulation. A large part of the literature (reviewed by Harrison, 1940) supports the belief that decreased activity of the hypothalamus results in somnolence and that increased activity of the hypothalamus results in bodily activity. The works of Kleitman and Ranson fit well together since, as pointed out by Harrison, it may be assumed that cessation of incoming impulses allows a decreased activity of the hypothalamus with a consequent decrease in its excitation of the brain and body.

Hypothalamic control of sleep alone could not explain the gonadal response of "light treated" birds. It has been shown, however, that the hypothalamus exercises some control over the gonadotropic functions of the pituitary (literature reviewed by Uotila, 1940; Brooks, 1940). It is well known that the anterior lobe of the pituitary produces the gonadotropic hormones. The production or release of these hormones is under the control of the nervous system in some instances, for it is evident that visual, tactile, and behavioristic stimuli can affect the pituitary in birds. In the pigeon, ovulation occurs only after copulation or as a result of emotional excitement; isolated birds do not ovulate. Sight of an incubating female induces in a male pigeon the changes necessary for crop milk secretion. For any species of bird the number of eggs in a clutch is generally constant, and when the proper number is attained, ovulation ceases and incubation begins. The stimulus for the cessation of ovulation may be tactile, or proprioceptive, or visual. After a critical survey of the field, Brooks concludes that there is much to suggest a neural modification of hypophysial gonadotropic functions, but very little conclusive evidence to prove or disprove this theory; in certain species experiments have clearly demonstrated that the hypothalamus influences the gonadotropic activity of the pituitary.

On the strength of this present knowledge of the relation of the hypothalamus to sleep and gonadotropic activity, I propose the following explanation of how increased daily illumination can cause recrudescence of the gonads under experimental and natural conditions. As the days increase in length, birds are awake for longer periods of time because the state of wakefulness, at least in some birds, is a conditioned response to light; the concomitant activity of the hypothalamus causes an increased production or release, or both, of the gonadotropic hormones from the anterior lobe of the pituitary; these, in turn, stimulate gonadal recrudescence. This is by no means the complete picture of what occurs, but it can explain adequately most of the results which have been obtained in light and activity experiments with birds.

The position of the hypothalamus in the above explanation is strengthened by the fact that it is the center for temperature regulation, and it plays a part in fat metabolism. Riley (*loc. cit.*) has shown that coincident with lowered body temperature mitotic divisions of the germ cells of the English Sparrow occurred almost exclusively at night. When compulsory exercise or light was administered at night, the mitoses diminished. A com-

plete reversal of day and night by means of shutters and artificial illumination also reversed the normal rhythm of mitotic activity and of body temperature. Wolfson (*loc. cit.*) has shown that during the early stages of gonadal recrudescence prior to migration a heavy subcutaneous and abdominal deposition of fat occurs.

In Rowan's activity experiments the importance of the training which the birds received in the daylight becomes apparent. The stimulus of jumping over the bar became an additional conditioned stimulus for the state of wakefulness, and that is why Rowan's birds showed some gonadal response. Bissonnette's experiments are difficult to interpret correctly because of the complicating factors which entered into them. In Riley's experiments, I believe the birds failed to show a gonadal response because the state of wakefulness was not conditioned to the stimulus provided by the revolving drum. If the birds had been conditioned to this stimulus during the day I expect the birds might have shown a gonadal response. However, to obtain this response they should not become abnormally excited, and their state of wakefulness and sleep should be approximately normal. Concerning the problem of a light receptor, the necessity of one is obviated if the hypothalamus controls the activity of the pituitary as described. The eye is essential in that under normal circumstances it is the only receptor which enables the state of wakefulness to become conditioned to light.

At this point it is necessary to consider some of the experiments of Benoit (1937), for it is on the basis of his results that the light theory is supported by so many authors. It should be noted that Benoit used domesticated Rouen ducks in his experiments.

Benoit demonstrated at first that if the head was completely hooded, there was no response to the increased illumination. If there was an opening in the hood in the region of the eye, however, there was a response to the light despite the fact that these birds were completely trussed in an opaque black cloth. Benoit concluded that light in the region of the eye induced gonadal development. It may be argued, however, that although the bird was immobile, the eye was stimulated and the state of wakefulness was evoked as a conditioned response to the light. The birds without perforations over the eye were not disturbed, but Benoit gives us no information on their behavior. Since the species is domesticated, it is not improbable that they did go to sleep, for the stimuli which normally maintain wakefulness were lacking. Birds with their backs plucked and exposed to light, but with their heads hooded, showed no response.

To determine the rôle of the eye Benoit performed the following experiment. Control birds, birds with one or two optic nerves sectioned, and birds with both eyes removed were placed in two mixed groups, one in a lighted room and one a dark room. In these groups were birds without hoods, with hoods, and some with hoods plus perforations over the operated eyes. In those cases where the light could strike the orbit, or eye with the optic nerve cut, there was a gonadal response. If the head was hooded there was no response, unless there was a perforation in the hood in the region of the eye. Benoit concluded that the eyes are not necessary for the gonadal response to artificial light. He does not give us any information about the behavior of the birds and it would be difficult to interpret this experiment from the standpoint of wakefulness. This experiment rather suggests that direct illumination of the cut optic nerve, or hypothalamus, or pituitary, or eye with optic nerve cut, can induce gonadal development.

In a similar experiment of Benoit's (1935), where normal birds were in the same pen with birds some of whose optic nerves were sectioned and others whose eyes had been removed, all birds showed a gonadal response. Rowan (1938a:382) criticizes this experiment by stating that the normal birds acted as a disturbance for the operated birds and hence induced wakefulness in them. This may be true for this experiment, but in the experiment cited previously, this criticism is invalid, because two normal birds were included in the group in the lighted pen.

Another series of experiments was performed involving direct illumination of the orbit with the eyes removed. In one experiment the orbits were plugged with hemispheres of opaque rubber. Eight birds with both eyes removed were free to move so that they received artificial illumination on their heads from all directions. Two birds with only the right eye removed had their heads solidly fixed on a board. The right orbit received a beam of light directed in such a manner that the region of the optic nerve, hypothalamus, and pituitary were at the center of the shadow cast by the rubber screen. The birds which were free to move and which had rubber cups in their orbits showed a good gonadal response, averaging a little less than the controls without the rubber cups. The birds fixed to the board showed no response. Benoit concluded that the photoreceptor organ which was situated behind the rubber cup was able to receive a little light in the birds which were free to move, but was protected from the light in the birds with their heads fixed to the board. This conclusion is difficult to accept. The controls without rubber cups which were fixed to the board did not show as great a response as the free-moving controls (lacking rubber cups). The response of the fixed controls was even less than in the birds which were free to move and which had rubber cups in the orbits! I think that some details of behavior or other complicating factors are obscuring the correct interpretation. Benoit does not give us any information on the behavior of the birds, nor does he state how and when they were fed. If they were hungry during the illumination they might have been in a state of wakefulness. The results of this experiment make one a little suspicious of the method employed. They suggest strongly that wakefulness may have played a part in the experiment.

That the "fixed birds" with cups showed no response is contradictory to the results of another experiment which was performed on a single bird. Under the eyelids of both eyes were placed lead plates a little larger than the eyeball. The eyelids were then sewn together. The bird was subjected to artificial illumination and it showed a considerable gonadal response. At the autopsy Benoit made a mid-sagittal section of the skull and concluded that the light passed around the metal plate and penetrated deeply, conducted by the tissues, or by diffusion. If the light was able in this instance to pass around the metal plate, why did it not pass around the rubber cup and diffuse through the tissues in the case of the bird whose head was fixed to the board? The behavior of the bird with the lead plates under the eyelids is not described.

In yet another experiment Benoit irradiated the region of the pituitary and hypothalamus directly through a tube of glass. He obtained a strong gonadal response. The illumination was given on two days only out of twenty, a total of about 28 hours being involved. On the basis of what is reported, it is difficult to interpret this experiment in any way but that direct illumination on the pituitary or hypothalamus causes increased production or release, or both, of the gonadotropic hormones. The light acting directly apparently can induce a gonadotropic reaction in the nervous and/or endocrine tissue. However this may be under experimental conditions, under natural conditions I do not think that light penetrates the tissues of the head to stimulate the controlling centers directly. Nor do I believe that a photoreceptor is essential. Peripheral impulses, such as auditory, tactile, and proprioceptive, if they are strong enough can induce wakefulness without the eye, although the eye is without question the most important receptor from the standpoint of stimuli which induce wakefulness.

Ivanova (1935) tried some hooding experiments with English Sparrows. The hood was made of a thin piece of silk and fixed to it in the region of the eyes were pieces of a black opaque material. Her results showed that the hooded birds developed nearly as fast as the unhooded. Benoit's explanation for this positive response is that light leaked around the opaque material. Since her unhooded birds were in the same room and re-

ceived the same illumination there is also the possibility that disturbance of the hooded birds caused wakefulness.

In hooding experiments, Ringoen and Kirschbaum (1937) obtained a positive response in 3 out of 9 birds. Again Benoit questions whether all the light was prevented from passing to the eye. No information is given as to housing or as to the construction of the hood.

From the results of Benoit's experiments it is impossible to conclude that wakefulness is not a complicating factor. Because he does not give the details of the housing and the behavior of the birds during the treatment, one cannot be sure that he has considered wakefulness as a factor. It seems rather that he has overlooked the matter completely. He has demonstrated that light directed at the region of the pituitary and hypothalamus can evoke a gonadal response. This does not indicate as Riley suggests that light, *qua* light, is the important factor involved and that wakefulness is unimportant. Under experimental conditions light so directed can evoke a response which simulates the response induced by daily increases in wakefulness.

It does not seem probable that daylight increasing 2 to 3 minutes a day under natural conditions penetrates the tissues of the head to stimulate the hypothalamus and pituitary. Light is an important factor in the regulation of the sexual cycle, but only in so far as it provides a stimulus for wakefulness. Since the wakefulness is under the control of the hypothalamus, the hypothalamus becomes the important timing center for the sexual cycle. Similarly, if birds are subjected to a constant short day length in the spring experimentally, the gonads undergo some recrudescence, but there is a great lag behind the normal development. Whether an inherent rhythm of the pituitary, or gonads exists is difficult to say. I think, however, that the lighting schedule which immature birds receive does materially influence their timing system. If this were not true how could one explain the nearly perfect coincidence of migration, or of nesting, in birds hatched one to three months apart?

In all types of environments there is usually a factor (or factors) which is periodic in its occurrence and which is an indicator of the best season for breeding. In the course of evolution this factor has become the regulator for the proper time of breeding through the responses evoked in the nervous system. If this were not true, many species would not have survived until the present day. The sexual cycles of migrants must be particularly well timed, for the breeding season of some species is very short. The hypothalamus, on the basis of recent work, seems to be that part of the nervous system which regulates the time of breeding and of migration. It is the integrator of the impulses concerned with the sexual cycle such as auditory, visual, tactile, and proprioceptive. In some species several of these impulses are important, while in others only one may be important. It has been shown in several instances that the sexual cycles of tropical birds and mammals cannot be manipulated experimentally with light. Yet, there is probably some factor in the environment which influences a timing center in the nervous system. The hypothalamus is probably involved in most species of birds and mammals and perhaps in other groups.

I wish to express my appreciation to Dr. Alden H. Miller, whose counsel has been invaluable in the preparation of this report.

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Museum of Vertebrate Zoology, Berkeley, California, March 15, 1941.

A GROUP OF BAT-EATING DUCK HAWKS

By KENNETH E. STAGER

Occasionally there comes to the field observer one of those fascinating opportunities of watching some bird or mammal behave in a manner entirely foreign to its usual pattern, or at least foreign to the pattern which it has been observed to follow in the past. The observations set forth in the following paragraphs deal with a group of Duck Hawks which have departed from their usual diet of aquatic bird life and are apparently using bats as the major item of their bill of fare. Literature contains many records of raptorial birds feeding upon bats and the following observations are similar in some respects to those of other writers, but also they tend to differ in many ways.

On August 5, 1938, my companion and I established camp on the ranch of a jovial Texan named Ben Gerdes. The Gerdes ranch lies among the low, forest-covered hills of the Balcones Escarpment in Medina County, of south-central Texas. On the ranch is a large limestone cave, known as Ney Cave. This cave is the diurnal retreat for a huge colony of Mexican free-tailed bats (*Tadarida mexicana*). The guano deposited by the colony has proved a source of revenue for the Ney family of D'Hanis, Texas, for many generations. It is from this family that the cave derives its name.

The area was purposely visited because of the widespread stories of the bat population of the cave. After several hours had been spent in studying the colony within the depths of the cave, my companions and I withdrew early in the afternoon in order to observe the spectacular bat flight which, according to Mr. Gerdes, "usually begins late in the afternoon, but several hours before darkness sets in, as the cave contains so many bats, that it is necessary for them to start coming out early, in order that the last ones to depart could leave before the first ones began to return."

As I stood in the ranch yard below the mouth of the cave, watching for the vanguard of bats which would announce the evening flight, my attention was drawn to the arrival of three Duck Hawks (*Falco peregrinus* subsp.) which instead of passing on around the hill began circling and making rapid dives through the air, directly above the mouth of the cavern. This maneuvering continued with an increase in the speed of the aerial acrobatics. The falcons would disappear for a short period and then suddenly reappear from around the hill, dashing horizontally through the air, directly above and slightly out from the cavern's mouth. Throughout this performance the falcons kept up a steady cry, similar to that given when in combat with a fellow bird over the possession of captured prey.

At this point, Ben Gerdes noticed my interest in the activities of the falcons and informed me that the performance was a daily affair at the cavern mouth and that the "blue dodgers" were "warming up" to catch their evening meal of bats. According to Mr. Gerdes, the falcons had been making a practice of catching bats at the cavern's mouth for many years. The rancher and his two sons kill the falcons at every opportunity, because of the depredations made upon the young poultry and also because of the number of bats that they kill. The Gerdes family hold the bats in high esteem and are careful to see that nothing harmful befalls the colony.

The three falcons had appeared at approximately 3:10 p.m. and by 3:30 their numbers had been reinforced by three more. The six birds continued to cry and dive at the cavern mouth as if they were calling the bats to come out. Suddenly a dark cloud of bats broke from the portal of the cave and poured out in a long stream to the east, flying directly over the ranch house at a height of about 300 feet. The column was approximately fifteen feet in diameter, with the bats flying in as compact a formation as possible. As the stream of bats emerged from the cave, it rose at an angle of almost 45°

for approximately fifty feet and then leveled off. The head of the column was soon lost to sight in the east where it disappeared beyond the tree-covered hills. The thousands of bat wings set up a decidedly noticeable roar, which tended to add to the awe-inspiring spectacle.

The instant that the bats made their appearance, the band of falcons set to work. Darting from above, or on the flank of the column, the birds would cut into the on-rushing mass of bats with talons set, and they seldom emerged on the opposite side without their prey held fast. Upon capturing a bat, a falcon would then skirt the tops of the trees covering the hillside and disappear around the hill, presumably to devour its prey. In a short time the bird would reappear and immediately join its companions in the harassment of the bat flight.

The bats apparently took no notice whatever of the falcons, except at the point at which the diving bird broke into the column. As the falcon flashed into the flying mass, collisions were inevitable and many times the birds would be deflected from their course.

The flight continued for over an hour and then began to dwindle in numbers. The number of falcons had diminished to two birds by this time, with the others presumably having fed to capacity. According to Mr. Gerdes, the flight just witnessed was only the "preliminary flight" and but an example of the main flight which customarily follows the vanguard after the lapse of approximately one hour.

The falcons were not observed to pursue solitary bats in the fashion of the Bat-eating Buzzard (*Machaerhamphus anderssoni*) of Africa (Lang and Chapin, Bull. Amer. Mus. Nat. Hist., 37, 1917:552), but seemed content to take their prey in the easiest manner possible, namely, by flying directly into the heart of the column and taking a victim as it came in contact with the bird's talons. To an observer it would seem an impossibility for the bird to break into this living mass without making a capture, but *Tadarida mexicana* is noted for its erratic and rapid flight, and the occasional emergence of birds with talons empty might be attributed to this fact.

At approximately 5:30 p.m. the main flight began, with the column emerging with the same volume and speed as the preceding flight. A pair of the falcons reappeared and began to harass the outcoming bats in a rather desultory fashion as compared to the gusto with which they had set upon their unfortunate prey earlier in the afternoon. Apparently because their crops were filled, interest in the flight had diminished. This second flight of bats from the cave continued until approximately 9:30 that night, as attested by the roar made by the countless thousands of wings.

Camp had been established along a pecan-bordered stream which flowed along the base of the hill in which the cavern was situated. The mouth of the cave was not over two hundred yards up the hillside from our camp, so that the noise made by the outgoing and incoming column of bats was clearly audible from this point. I awoke at 3:00 a.m. to the roar of the incoming flight. Shortly after 4:00 a.m. it became light enough to see, and I arose and made my way up the hillside to the mouth of the cave. The return flight was made in a different manner from the evening flight in that the incoming bats flew to a point several hundred feet directly above the cavern's opening and then volplaned downward and into the yawning mouth of the cave at a terrific rate of speed. By training one's eye to the top of the descending column, bats could be discerned approaching the "diving point" from all points of the compass.

The mouth of Ney Cave opens as an oval doorway, ten feet high and twenty feet wide. This made it necessary for the descending bats to execute a sharp turn as they entered the cave. Taking up a position on the hillside directly over the mouth of the cave, I found myself within ten feet of the rapidly descending column of bats. They

were so close that the ripple of air on their wing membranes was clearly audible and much like the sound produced by air being rippled over rubber sheeting.

Shortly after daylight, the Duck Hawks put in their appearance and immediately set to work securing their morning meal of bats. The capture of incomers was not as easy a feat as that of the preceding evening, largely because the incoming column was not as compact as the outgoing stream and was descending at a much greater speed.

Although the catches of the falcons were less numerous, the birds seemed not the least discouraged and worked with great alacrity. Upon making a capture, a falcon would immediately retire to a point out of sight around the hill, as had been done on the previous evening. I was armed with a shot gun and in one instance fired at a bird as it started to make off with a bat in its talons. The gun was not of a suitable type for stopping Duck Hawks, however, and the charge of shot only made the falcon drop its prey. The limp body of the bat dropped on the open hillside and when retrieved it was found to be lifeless, with deep talon punctures in its body. Apparently the falcons were not devouring their prey on the wing as is done by *Machaerhamphus*, but retired to some favorite perch out of sight around the hill, for without exception the birds would fly away as soon as a bat was secured.

The birds continued to raid the incoming stream, but began to work at a greater height, out of range and danger of my gun. I had not taken any precautions to conceal myself as my primary desire was to get as close to the descending column of bats as possible.

On the ground just outside of the cavern mouth lay the decomposed bodies of two of the "blue dodgers" which had fallen victim to the gun of the rancher's son. One of the bodies was in a better state of preservation than the other and from it a complete skeleton was secured for later identification. The bones are now in the collection of the Los Angeles Museum.

The spectacle of the Duck Hawks feeding on the colony of *Tadarida mexicana* is of great interest for many reasons. Aside from the fact that the birds were securing food of an unusual nature and in a unique manner, it causes one to pause and consider the unusual concentration of Duck Hawks in the vicinity of the cave. Did the surrounding area have an overabundance of Duck Hawks or were the birds drawn to the area by the presence of the bat colony and the huge food reserve which it offered? As far as endangering the existence of the bat colony is concerned, the depredations of the falcons would seem insignificant because of the enormous size of the colony.

The time allotted for studying this enormous chiropteran colony and its predators came to an end only too soon, but at a future date I hope to return to the area and continue observations over a longer period of time. From what has been seen it would seem that the Duck Hawk can definitely be listed as a bat predator if given an ideal situation such as the one just described. Because of the early emergence and late arrival of portions of the bat flight, the activities of the falcons can hardly be termed crepuscular, as in the case of *Machaerhamphus*. The situation at Ney Cave appears to agree with reports of other authors that colonies of bats preyed upon by birds are usually those of the early-flying, free-tailed family, Molossidae.

Los Angeles Museum, Los Angeles, California, March 20, 1941.

THE PASSING OF CORAGYPS SHASTENSIS MILLER

By LOYE MILLER

During my early work upon the fossil birds of California, a student in the field of palaeornithology was accustomed to thinking in very limited terms as regards either number or completeness of specimens. This limitation was somewhat expanded by the earlier and restricted excavations at Rancho La Brea. We were elated when several hundred bird bones had been retrieved by the time the University of California was obliged to cease its operations in that locality, and we even thought that the asphalt beds had been practically exhausted. Little did we dream that greatly extended activity in the locality would be undertaken and that an almost bewildering wealth of bird bones would ultimately be assembled.

In this early period, a small collection of bones of vultures of the genus *Coragyps* was allocated to the new species *occidentalis* (L. Miller, Univ. Calif. Publ. Bull. Dept. Geol., 5, 1909:306). The study of Rancho La Brea was supposedly completed and work on a collection of bird remains from the Shasta Caves was undertaken. In this latter collection there appeared a few bones assignable without question to *Coragyps*, but quite as definitely not assignable to the species *occidentalis* as then known from Rancho La Brea. The species was described as new under the name *C. shastensis* (L. Miller, Univ. Calif. Publ. Bull. Dept. Geol., 6, 1911:388).

No further specimens of the Shasta bird have ever come to light. At a later date the exploration of Rancho La Brea was resumed with great vigor by the University of California and by the Los Angeles Museum. The two faunas of McKittrick, two at Carpinteria, and the two of uncertain age at Conkling Cavern, New Mexico, and Smith Creek Cave, Nevada, all have yielded more or less material of *Coragyps occidentalis*. More recently the California Institute of Technology has uncovered abundant remains of the same bird in the state of Nuevo León, Mexico. This new material has all been made available to me through the courtesy of Dr. Chester Stock.

Particularly in the Mexican cave do we find age variations all the way from scarcely ossified nestlings to quite old and probably senile individuals. The species apparently used the cavern mouth for nesting, for roosting, and probably for retirement when vitality was reduced by age or other cause. There is no evidence of extreme youth in any of the asphalt specimens, but there is great range of variation in this tremendous series, and part of this variation is doubtless due to the factor of age.

A study of the Rancho La Brea and the Nuevo León series convinces me of their specific identity, and within each series there can be found individual tarsi that practically duplicate the type specimen of *Coragyps shastensis* described in 1911. That species, then, in my opinion passes into the synonymy of *Coragyps occidentalis* described in 1909. Parenthetically, I may say that the other Shasta vulture, *Gymnogyps amplus*, was at the same time re-examined and compared with the great series of California Condor bones from Rancho La Brea, but there was found no specimen that duplicated the great width of tarsus seen in the Shasta bird.

Had those intermediate variants of *Coragyps* been permanently lost, we would have been quite content to recognize two perfectly distinct species. In the horizontal, two dimensional plane of present day geographic distribution, we would often find ourselves obliged to formulate distinct specific categories were the intermediate portions of a species area left unexplored or were they to undergo such profound ecologic change as to make them lethal to the species concerned.

The paleontologist, working with his highly disjunctive record, finds that the fortuitous nature of the fossilization process has robbed him of the "intergrade" specimen and he is quite ready to establish distinct specific categories.

After all, were we able to restore all the intermediates blotted out by that great third dimension of the paleontologist, time, we would doubtless have most known species relegated to the less definite varietal category.

University of California, Los Angeles, March 10, 1941.

SPRING FLIGHT OF THE DIVING DUCKS THROUGH NORTHWESTERN IOWA

By JESSOP B. LOW

In the three-year period from 1938 to 1940 the writer has had the opportunity of observing the spring flight of diving ducks passing through northwestern Iowa. These observations supplement recent publications (Bennett, 1934, 1938; Spawn, 1935; Scott and Sooter, 1937; Low, 1939) on the migration of game birds through this state. Acknowledgment is made of supervision in this research by Dr. George O. Hendrickson, Iowa State College, and Thomas G. Scott, United States Fish and Wildlife Service, and of the cooperation of the Iowa State Conservation Commission and the American Wildlife Institute.

The lake and marsh region in which observations were made is in Clay and Palo Alto counties near Ruthven. Because of its proximity to Ruthven the area will be referred to as the Ruthven area. The lakes and marshes in this region are typical of those of the Wisconsin glacial drift and form part of the southern apex of the triangular pattern of lakes and marshes extending southward from southeastern North Dakota.

Observations were begun in mid-March each spring at which time the vanguard of the waterfowl had arrived. Although not the first ducks to reach Clay and Palo Alto counties on their spring flight, the diving ducks came between March 20 and 30.

Water levels in the lakes and sloughs at the commencement of spring migration in 1940 were 24 inches below those of the same date in 1939 and were approximately 16 inches below those of 1938. The two-foot drop in water level in 1940 eliminated or rendered unattractive a third of the potholes and marshes formerly supplying open water areas for the spring migrants.

The ice cleared from the large lakes and sloughs under observation on March 22 in 1938, March 26 in 1939, and on April 5 in 1940. Small, shallow-water areas were free of ice several days before the main lakes and marshes. The late date at which the ice melted from the lakes and marshes in 1939 and 1940 appeared to affect the diving ducks more than the shoal water species by excluding them from their food supply. Shoal-water ducks feeding in the corn fields were not so drastically affected by the generally frozen state of the lakes as were the divers. A close correlation between the arrival of the diving ducks and the opening of the water was noted for the three years. Reference to table 1, which shows the dates at which the birds were first observed, indicates a lag of about one week in the date of the arrival of most of the diving-duck species in 1940 as compared to 1938 and 1939.

Choice of habitat in the early part of the season was governed primarily by the availability of open water. As the lakes and marshes cleared of ice, the diving ducks moved to ever-deeper water. The presence of shallow potholes free of ice, no matter how small or how large, was apparently welcomed by all the ducks; both diving and "puddle" ducks concentrated to dabble and drink in the new water. It was not uncommon to see groups comprising Mallard (*Anas p. platyrhynchos*), Redhead (*Nyroca americana*), Lesser Scaup (*Nyroca affinis*), Blue-winged Teal (*Querquedula discors*), American Pintail (*Dafila acuta tzitzihoo*), and Baldpate (*Mareca americana*) in pools only four or five feet in diameter.

The water areas first available were marshes bordered by closely grazed pasture where cattle trampling during the previous season had left muddy shorelines. Into these edges poured thousands of waterfowl at the first thaw of the season. From then on the diving and shoal-water ducks took more and more divergent courses as the former

sought the ever deepening water as ice melted, while the shoal-water ducks were content to dabble in the shallow water at the edges of ponds.

The first diving ducks to arrive were not seen to feed in corn fields as were the majority of the mallards and pintails, but sought, instead, a small spring which remained open throughout the winter. After the "first flight" of approximately 50 Red-heads on March 21, 1940, no diving ducks were observed until March 29. On that date the first Ring-necked Duck (*Nyroca collaris*), Lesser Scaup, Canvas-back (*Nyroca valisineria*), and American Golden-eye (*Glaucionetta clangula americana*) were seen.

Abnormally cold weather persisted in northwestern Iowa from March 21 to April 1 and similar conditions farther south might have been responsible for the difference of one week to ten days in the arrival of the diving ducks in 1940. However, as pointed out by Lincoln (1939) the relationship between local weather conditions and the flight of the migrant birds is not always close.

Dates of departure of the diving ducks from the Ruthven area did not differ greatly in the three years. Those on which the various species were last observed are given in table 1. Since four of the seven species nest in Iowa, dates on which the last migrants were observed could not be determined and these birds are indicated in the table as "nesting."

TABLE 1
Spring flight of the diving ducks through Clay and Palo Alto
counties, Iowa, in 1938, 1939 and 1940

Species	Date First Observed			Date Last Observed			Date of main flight		
	1938	1939	1940	1938	1939	1940	1938	1939	1940
Redhead	Mar. 20	Mar. 22	Mar. 21	Nesting	Nesting	Nesting	Mar. 24- Apr. 18	Apr. 11- Apr. 18	Apr. 15-
Ring-necked duck	Mar. 20	Mar. 22	Mar. 29	May 12	Apr. 29	May 8	Mar. 28- Apr. 1	Mar. 25- Apr. 4	Apr. 1- Apr. 8
Canvas-back	Mar. 15	Mar. 22	Mar. 29	Nesting	Nesting	May 15 Nesting	Apr. 18	Mar. 25- Mar. 28	Apr. 1- Apr. 15
Lesser scaup duck	Mar. 15	Mar. 21	Mar. 29	Nesting	Nesting	Nesting	Apr. 1- Apr. 22	Apr. 1- Apr. 15	Apr. 8- Apr. 15
American golden-eye	Mar. 19	Mar. 21	Mar. 29	Apr. 13	Mar. 21	May 2	Apr. 3	Mar. 21	Apr. 8- Apr. 15
Buffle-head	Apr. 9	Mar. 27	Apr. 2	May 9	Apr. 29	May 6	Apr. 1	Apr. 1	Apr. 8
Ruddy duck	Apr. 14	Mar. 23	Apr. 2	Nesting	Nesting	Nesting	Apr. 29	May 2	May 6

After the water areas had cleared of ice in late March or early April, the selection of certain lakes and marshes by the diving ducks appeared rather definite. Those with water depths of about 18 inches to 5 feet were frequented by the majority of the diving ducks, although deep-water lakes also were used for resting in raft formations at night. During severe storms water areas having protective cover in the form of high banks, wooded shores, or dense stands of emergent vegetation were eagerly sought by all of the ducks. Hardstem bulrush (*Scirpus acutus*), cattail (*Typha angustifolia*, *T. latifolia*), river bulrush (*Scirpus fluviatilis*), reed (*Phragmites communis*), and giant bur-reed (*Sparganium eurycarpum*), appeared to offer the greatest protection to the ducks under these conditions. Willows (*Salix* spp.), cottonwoods (*Populus* spp.), and oaks (*Quercus* spp.) with understories of ragweeds (*Ambrosia* spp.) were the kinds of shore vegetation utilized as a windbreak during the storms and high winds. As the migration neared an end, diving ducks remaining to nest were more frequently found in bays of the larger

lakes partly protected by willows or cottonwoods. In these bays, where the wind was checked and submerged foods were abundant, courtship and mating took place.

In general, the various species of diving ducks chose similar water areas on their spring migrations and often mingled freely. About the first of April, separate rafts of Scaup, Redhead, and Canvas-back were observed on the waters of Lost Island, Trumbull, Mud, and Virgin lakes, whereas toward the middle of the month mixed flocks of ducks were observed. It was not an uncommon sight to see all seven of the species of diving ducks in a water area not more than a hundred yards square. However, toward the end of the migration period stray individuals were observed flying from group to group in search of their particular kind. This was well demonstrated by an instance in which a male Redhead alighted in the midst of a group of Canvas-backs. After swimming through the flock, it flew to a second group and to yet a third, finally alighting in a group of Redheads in which it immediately became an indistinguishable unit. Small groups of Ruddy Ducks (*Erismatura jamaicensis rubida*) and Buffle-heads (*Charitonetta albeola*) remained in groups even in the midst of larger flocks of Canvas-backs, Scaups and Ring-necked Ducks.

TABLE 2
Sex ratios of diving ducks during spring migrations through northwest Iowa
(Figures in parentheses are numbers of migrants counted for sex ratios.)

Species	1938 Male : female	1939 Male : female	1940 Male : female	3-year total Male : female
Redhead	1.45-1 (511-303)	1.43-1 (1,050-743)	1.23-1 (438-355)	1.42-1 (1,999-1,401)
Ring-necked duck	1.48-1 (421-284)	1.76-1 (484-218)	1.43-1 (107-75)	1.77-1 (1,012-577)
Canvas-back	2.04-1 (233-144)	2.14-1 (208-97)	1.84-1 (96-52)	2.04-1 (537-263)
Lesser scaup	2.14-1 (1,984-923)	2.20-1 (494-224)	2.44-1 (330-135)	2.19-1 (2,808-1,282)
Buffle-head	1.42-1 (151-106)	2.10-1 (21-10)	1.73-1 (147-85)	1.58-1 (319-201)
Ruddy duck	1.25-1 (307-245)	1.89-1 (123-65)	1.59-1 (67-42)	1.41-1 (497-353)

The unbalanced sex ratio among ducks has been discussed by Lincoln (1932), McIlhenny (1934, 1940), and Furniss (1935). Large numbers of wintering ducks banded in southern Louisiana formed the basis for McIlhenny's conclusions, whereas Furniss chose a marsh and pothole nesting habitat in Saskatchewan as an area in which to make sex ratio counts. A record kept of the spring migrant ducks through the Ruthven area, 1938-1940, showed a difference in the sex ratio similar to those noted by the above-mentioned investigators. Tri-weekly observations were made on four lakes and ten marshes, the smallest being 10 acres in area and the largest 1200 acres. No attempt was made to determine the sex of all the ducks observed. Small flocks and rafts were counted, but where the ducks could not be tabulated individually, no record was made. Counts on the species infrequent in the Ruthven area are included even though the numbers were small, and where few birds of a species were observed, the sex of all was recorded so far as could be accurately determined. The numbers of ducks upon which the sex ratios were based (table 2) do not indicate in all instances the relative abundance of the species.

The number of males regularly exceeded that of the females in all species. Of special interest is the absence of any large variation in the sex ratio from year to year within a species. Table 3 presents a comparison of the male : female ratio as observed on the

wintering grounds in Louisiana, during the spring migration through northwest Iowa, and on the nesting grounds in Canada. The largest variation appears in the Ring-necked Duck. More than three and one-third times as many males as females occur on the wintering grounds, and nearly twice as many males as females in migration, while on the nesting grounds of Saskatchewan the males only slightly exceeded the females. A high excess of Ruddy Duck males (2.3:1) was noted on the nesting grounds of Canada as compared to the ratio (1.4:1) that prevailed during the spring flight through Iowa.

TABLE 3

Sex ratios of diving ducks on the nesting grounds (Saskatchewan, 1935-1937), spring migration (Iowa, 1938-1940), and wintering grounds (Louisiana, 1934-1938). Figures in parentheses are numbers of birds counted for sex ratios.

Species	Ratios at Ruthven, Iowa, 1938-40 Male : female	Ratios at Avery Island, Louisiana, 1934-1938 Male : female	Ratios at Saskatchewan, Canada, 1935-1938 Male : female
Redhead	1.42-1 (1,999-1,401)	-----	1.14-1 (72-63)
Ring-necked duck	1.77-1 (1,012-577)	3.35-1 (4,711-1,405)	1.15-1 (30-26)
Canvas-back	2.04-1 (537-263)	1.74-1 (343-197)	1.26-1 (216-171)
Lesser scaup duck	2.19-1 (2,808-1,282)	2.22-1 (5,761-2,595)	1.56-1 (696-446)
Buffle-head	1.58-1 (319-201)	-----	1.80-1 (34-19)
American golden-eye	2.23-1 (29-13)	-----	1.13-1 (35-31)
Ruddy duck	1.41-1 (497-353)	-----	2.29-1 (96-42)

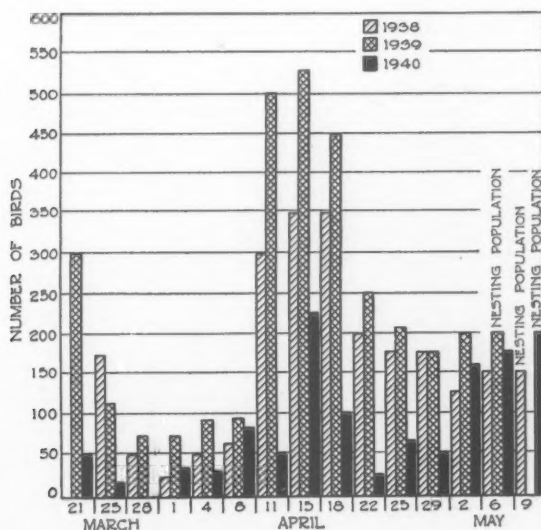


Fig. 33. Spring flight of the Redhead in northwestern Iowa.

The following are the principal points of interest in the spring flights of each of the seven species of diving ducks frequenting the Ruthven area in the years 1938, 1939, and 1940.

The Redhead migration was rather irregular; the earliest bird was noted March 21. In all three years the numbers observed dropped immediately after March 21 to a small vanguard and increased again from April 11 to 18, the period of the principal flight (fig. 33). In 1940 the numbers, as shown in the figure, were not more than half those of the preceding years, 1938 and 1939, until near the end of the flight. The numbers of migrant Redheads reached a peak on April 15, 1940, and then dropped sharply. At the end of the spring flight of 1940 the numbers had increased until the nesting population remaining in the Ruthven area was only slightly under the resident populations of 1938 and 1939. Whether these Redheads came in from the south at the end of the season or returned after flying farther north is problematical.

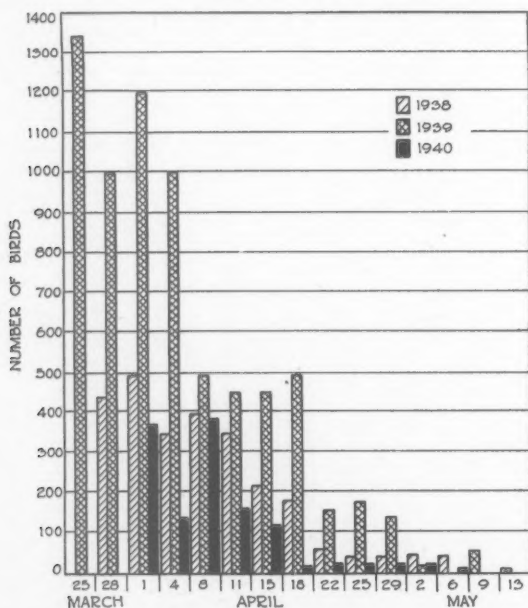


Fig. 34. Spring flight of the Ring-necked Duck in northwestern Iowa.

Migrating Redheads were observed in the protected bays and marshes in a sex ratio of 1.42 males to 1 female. Courtship was well advanced and mating had often taken place when the birds arrived.

Bays of the large lakes presented favorable habitat for the Redhead. Study of one of the favored resting and feeding sites revealed that the two-acre bay held water approximately 48 inches deep and was surrounded by willows and poplars on the east, west, and south shores while the north side of the bay opened into the lake. Approximately 25 per cent of the water was covered with dry dead vegetation of the previous season or with willows in the following proportions:

Narrow-leaved cattail: 20 per cent; emerging 4 inches above water; matted in clumps.
 Hardstem bulrush: 70 per cent; emerging 18 inches above water.
 Willows: 10 per cent; emerging 4-6 feet above water.

The spring flight of the Ring-necked Duck in 1939 far exceeded that of either 1938 or 1940. This species was first observed on March 20 in 1938, March 22 in 1939, and March 29 in 1940. The peak numbers (fig. 34) were reached on March 25, 1939, when approximately 1500 to 1800 ducks were in the lakes and marshes. It was conservatively estimated upon the basis of daily counts that approximately 12,000 Ring-necked Ducks were observed in 1939, 10,000 in 1938, and 5000 in 1940. The late opening of the lakes and marshes may have been responsible for the decline in numbers in 1940. The height of the spring flight extended from March 20 to April 4 in 1939 and varied but slightly in 1938. The 1940 migration was about 10 days later, April 1 to 8. The numbers of these birds gradually decreased as the flight season passed. May 12 in 1938 and April 29 in 1939 were the dates on which Ring-necked Ducks were last observed in the Ruthven area.

Ring-necked Ducks in spring flight associated principally with the Scaups, Canvas-backs, and Redheads, although a few were observed with Buffle-heads, Mallards, and Pintails.

In contrast to the other spring migrant diving ducks, which showed no great yearly fluctuations, the Canvas-back came in numbers nearly ten times greater in 1940 than in 1938 and 1939. Reference to figure 35 and table 1 shows that the spring flights were at their height on approximately April 18, March 25 to 28, and April 1 and 15, in the 1938, 1939 and 1940 seasons, respectively. A few individuals were noted with

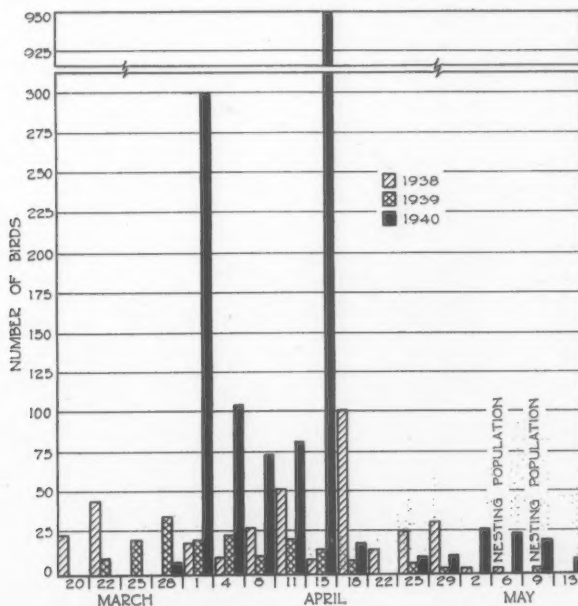


Fig. 35. Spring flight of the Canvas-back in northwestern Iowa.

Scaups and Ring-necked Ducks, but the majority of the Canvas-backs traveled in unmixed flocks.

Virgin Lake, a body of approximately 450 acres, well filled with submerged food plants but having no emergent plants, and Trumbull Lake (1250 acres), similar in all respects to Virgin Lake, were the two lakes upon which the Canvas-backs concentrated in the course of the spring flights. Both were about 4 to 6 feet deep with muddy bottoms, unobstructed views, and plenty of food plants. On April 15, Virgin Lake held approximately 500, and Trumbull Lake held 400, Canvas-backs. On the night of April 17, 90 per cent of the birds departed. This leaving was correlated with a rapid rise in temperature.

Although no nests were found in the three nesting seasons, broods of Canvas-backs were observed in Barringer's Slough, outlet of Lost Island Lake, in 1938 and 1940, and a brood was seen in a 40-acre bay of Lost Island Lake in 1939. However, in 1934 a Canvas-back nest was found in Barringer's Slough (Bennett, 1937).

In total numbers observed the Lesser Scaup far exceeded all the other diving ducks for the three spring flight seasons. The 1938 flight of this species was greater than those of 1939 and 1940, the latter being the lightest of all.

There was a difference of fifteen days between the date of first arrival in 1938 (March 15) and that of 1940 (March 29). Approximately 40,000 scaups were observed in 1938, 25,000 in 1939, and 20,000 in 1940. The main migration period, April 1 to 20, was approximately the same each year. Numbers of migrants in 1939 and 1940 gradually increased to the climax of the flight on April 8 and then gradually decreased, whereas in 1938 the ducks came in their top numbers almost overnight and fluctuated only slightly through a period of three weeks.

The scaups were abundant on all the larger bodies of water of the region, particularly Lost Island Lake, Trumbull Lake, Mud Lake, and Round Lake. These ducks in the main chose areas of smaller size in which to rest and feed during migration than

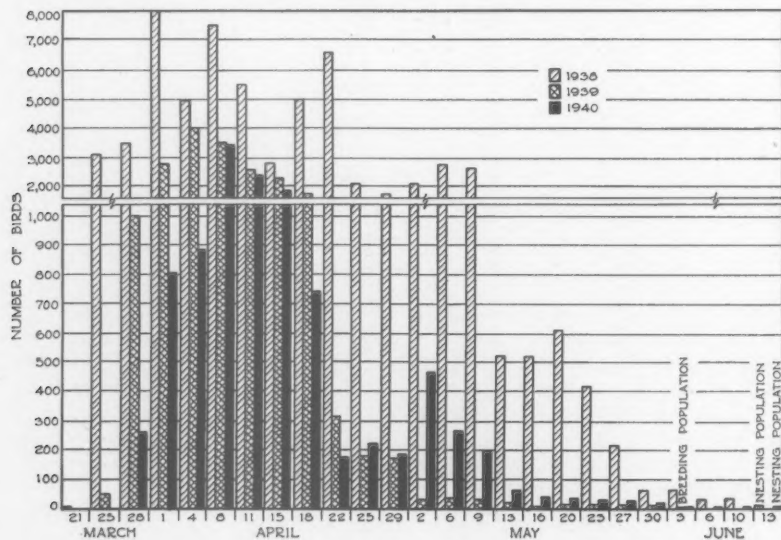


Fig. 36. Spring flight of the Lesser Scaup Duck in northwestern Iowa.

did the Canvas-backs. A favorite haunt of the scaup was the west end of Mud Lake, a partly open body of water protected by oak, willow, and poplar trees on the bank and dead hardstem bulrush, reed, and cattail at the water's edge. The shift from shallow water lakes to deep water lakes as the ice melted was particularly noticeable in this species. Scaups were observed to associate with every species of duck passing through the Ruthven area, but like the Canvas-back migrated largely in unmixed flocks. Sex ratios varied but slightly from year to year; an average of 2.14 males to 1 female was recorded.

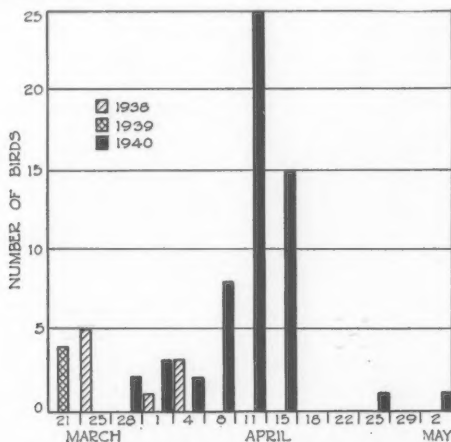


Fig. 37. Spring flight of the American Golden-eye in northwestern Iowa.

The Golden-eye did not pass through the Ruthven area in any great numbers in the three-year period of observation. Reference to figure 37 shows that numbers of the Golden-eye in 1940 far exceeded those observed in 1938 and 1939. Nine birds were seen in 1938, 4 in 1939, and 52 in 1940. The height of the spring migration season could not be detected accurately in 1938 and 1939 because of the small numbers observed. However, March 19 and 21 were dates when most individuals were observed in those two years. In 1940 the birds came to the Ruthven area on March 29 along with the majority of the diving ducks, but the peak of the migration was not until April 11 to 15. The larger open lakes were much preferred by spring migrant Golden-eyes. The 1200-acre Lost Island Lake attracted the largest number and Trumbull Lake (1150 acres) appeared to be second choice. Both of these lakes were free of emergent vegetation and offered good feeding conditions. Golden-eyes were frequently observed feeding in water 2 to 6 feet deep within from 5 to 20 yards of the shore. High winds and cold weather did not drive these ducks to the shelter of banks or vegetation.

The sex ratio of the Golden-eye for the three-year period of observation was 2.37 males to 1 female. Courtship was not detected in the Ruthven area, but pairs were observed that evidently had mated before their arrival. Except when in fairly large groups (10 or more) the Golden-eyes intermingled and associated with Scaups, Ring-necked Ducks, Canvas-backs and Redheads, although pairs were often observed alone on large open bodies of water.

March 27, 1939, was the earliest date on which the Buffle-head was observed and May 9, 1938, the latest. Main flights were on April 1 in 1938 and 1939, and April 8

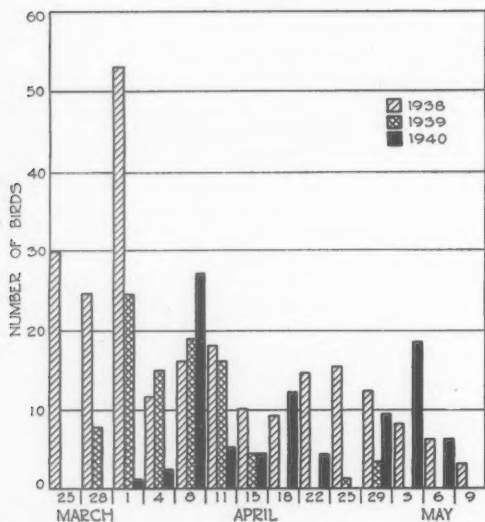


Fig. 38. Spring flight of the Buffle-head in northwestern Iowa.

in 1940. Approximately 200 birds were observed each spring. Buffle-heads were not observed in large flocks but in groups of 5 to 10 individuals. Courtship was carried on in earnest within these small groups. The sex ratio of the Buffle-heads observed was 1.66 males to 1 female. What appeared to be non-breeding juveniles were in evidence

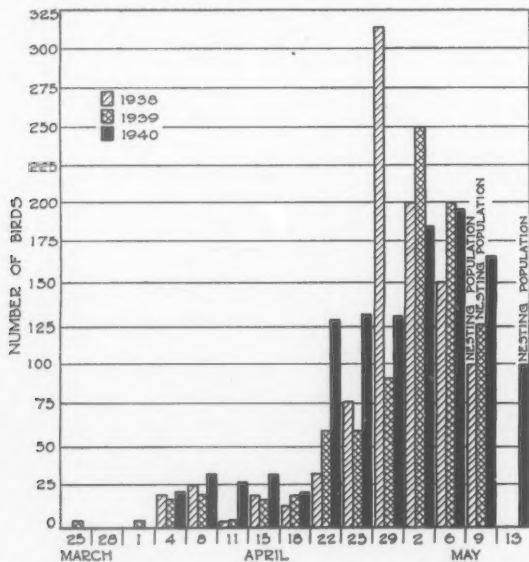


Fig. 39. Spring flight of the Ruddy Duck in northwestern Iowa.

within these groups. These birds flew and swam with the group but played no part in the courtship.

Buffle-heads were observed in the same habitat occupied by the Scaup, Canvas-back and Ring-necked Ducks. However, this species scattered a great deal over the lakes and deeper marshes with no concentrations at any point. Lost Island Lake, Round Lake, and Trumbull Lake were favored waters in which the Buffle-heads were observed courting and resting.

Although not belonging to the subfamily Nyrociniae, the Ruddy Duck (subfamily Erismaturinae) is included in this discussion because of its close association with the other diving ducks. The spring flight of the Ruddy Ducks involved a gradual increase in numbers from the date of their first appearance, March 23 in 1939, to the peak of the migration, April 29 to May 6. Migrating largely at night, the birds were often observed in early morning in large concentrations on areas that were free of Ruddy Ducks the previous day. At the height of migration Ruddy Ducks traveled together in flocks numbering up to 200, but they were observed resting and feeding alone or in groups with an occasional Canvas-back, Scaup, or Redhead on the open water of Trumbull and Lost Island lakes. All did not travel in large flocks, however, for many migrated in pairs or small groups of three or four and frequented vegetation-covered water. Apparently these pairs and small groups remained to breed in the Ruthven area.

The sex ratio of the Ruddy Duck was 1.4 males to 1 female for the three years. There was little variation in the total numbers of Ruddy Ducks migrating through the Ruthven area during the period of observation. Approximately 1000 were observed each spring, of which about 50 pairs remained to nest.

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VOICE IN THE BROWN TOWHEE

By CHARLES W. QUAINANCE

The Brown Towhee (*Pipilo fuscus*) has a fairly large, though not strikingly varied, repertoire of notes. It is the purpose of this article to survey these notes, with the exception of the male song which has already been discussed (Quaintance, Condor, 40, 1938:97-101), and to comment on their significance. Observations forming the basis of these statements were made chiefly on the towhees (*P. f. petulans*) in the vicinity of Berkeley, California, in 1937.

The tsip note.—The most familiar note of the Brown Towhee is the loud clear metallic *chip* or *tsip*. This note may be given with monotonous regularity for as much as twenty-five minutes at a time. The frequency of the *tsip* note varies. Ten a minute may be given, but thirty is the most usual number.

The *tsip* note is not necessarily correlated with activity, although it does announce the beginning of activity in the early mornings and again, the cessation of activity in the evenings before the towhees go to roost. On the other hand a towhee may *tsip* for fifteen minutes without any activity. In flight it may give several *tsips* or none at all. An emphatic *tsip* may announce the take-off, and a *tsip* or two may be given upon alighting from a flight. A towhee may *tsip* on the ground while it is foraging, or it may forage for minutes without giving a sound. Frequently, in the nesting season, the *tsiping* is done from a high station such as the top of a laurel tree, or thirty or forty feet up in a eucalyptus, or from the peak of the highest available house or telephone pole.

The general *tsip* note seems to have different functions. It may serve as a contact note between birds, especially birds of a pair, as a protest note, or as an alarm or warning note. Further study of this note may yet resolve it into at least three different notes corresponding to the behavior induced. In other words, although the *tsip* may sound the same to us, the variations in manner of delivery or loudness may have meaning.

The *tsips* of a female disturbed at the nest are immediately answered by her mate and if her notes become hurried and excitable, he may come racing in to her side, no matter what part of the territory he may be in. Both birds may then utter loud *tsips* of protest at an intruder. This protest note invariably brings neighboring towhees close to the nest in disregard of territorial boundaries. Birds of other species are also attracted to the region of the nest in apparent curiosity. The Spotted Towhee, the Western Flycatcher, the English Sparrow and the Robin have been found to come.

The tsink note.—In the nesting season the *tsip* note of the adult often takes on a *tsink* sound; it then has an extremely rapid tempo. One adult towhee, with young probably under cover, gave over eighty to a minute (May 13). Another gave ninety-seven in one minute.

Both the *tsip* and the *tsink* variation are effective in controlling behavior of the young. For instance a male parent gave these notes sharply to hush the hunger notes of its fledgling which "froze" at once. Even at the age of forty-three days a fledgling "froze" at the warning *tsip* of its parent.

Banded nestlings eight or nine days old, when released on the ground, followed the *tsips* of their parents to cover. The rapid *tsink*, besides acting as a warning to the young, probably warns the female if she is on the nest.

The tssp note.—There is another variation of the *tsip* note, a much softer one which is less audible to the human ear. It is an aspirate *tssp* or *tss*. Hunt (Condor, 24, 1922:203) wrote that it is "a faint high attenuation of what we may call the family 'tseep' of the Fringillidae, some version of which is found in most of the sparrows."

Given softly and slowly, this note seems to have the effect of keeping mated birds in contact when they are only a short distance apart yet are hidden from each other, as by thick shrubbery. A single captive bird voiced a few loud *tsips* whenever startled, but otherwise it was either silent or else gave this faint *tssp*. At first the *tssp* note was given frequently, but after a few days, less often; it may have given this note to locate its mate. Once when a stuffed skin was placed in its cage, it hopped around it quietly and persistently, intermittently giving the *tssp*.

Hunger notes of the young.—The hunger note of the nestling is *puhlee*; this is reminiscent of the doorbell song of the Spotted Towhee (*Pipilo maculatus*). This note of the nestling is a chorus kept up by the young birds for as long as thirty seconds at a time; it reaches a peak at about twenty seconds. In the nest the open, up-tilted gape of a nestling is probably a great stimulus in itself to the adults, but the *puhlee* of the young is undoubtedly a strong factor in awakening the feeding reaction of the parent.

The hunger note of the fledgling is quite different from that of the nestling; it is loud and penetrating. It is *tst tst tst*, similar in general pattern to the hunger notes of the young of many sparrows such as the Song Sparrow, but it is probably louder than those of most of the other sparrows. The note is given slowly at first, but is greatly accelerated when the adult approaches with food. This *tst tst tst* of the fledgling may be sufficient stimulus to send the parent bird searching for insect larvae or other food which they feed the young. The biological utility of the hunger notes of both the nestling and the fledgling is obvious.

First notes in young birds.—Young birds give a note which approximates the faint *tssp* of the adult. The *chip* of a sixty-hour old nestling was given very faintly with each exhalation. The *chips* of birds several days older are answered by *tsips* from the parent. Fledglings do not give the sharp adult *tsip* for some time, but they give a *tseep* note while hopping.

The towhee squawk.—Whenever towhees are handled, an utterance is given which is not unlike that of the squawk of a young chicken. It rather startles the holder. Even nestlings have this squawk. A nestling put on its back utters this squawk while trying to right itself. The squawk of a young bird appears to act as a signal of distress to the parents, since they become greatly excited, rushing to the scene and *tsiping* loudly.

When the squawk note is given by an adult in nature, it may serve as an intimidation note as well as a note of distress. On one occasion the writer was attracted by a series of piercing squawks from a towhee. The bird had lost control of its wings, and when placed on the ground, it could only spin around on its back. What caused the squawking was not apparent, although California Jays (*Aphelocoma californica*) on the ground at the scene may have been implicated. The notes were surely those of distress and may have served to intimidate the jays. If a predator seized a towhee, such a series of terrified squawks might conceivably be of survival value in causing the predator to relax its grip for the instant necessary to permit the towhee to reach cover.

The mate-call and its significance.—A most familiar utterance of the Brown Towhee is one which Hunt (*loc. cit.*) described as "a succession of eight or nine rather distressed-sounding squeaking sounds, somewhat as one might squeak with one's lips." His use of the adjective "distressed" indicates that he misconstrued its significance. It is true that the appearance of the birds when giving this note may lead an observer to think that the birds are quarreling. For instance, two birds may be foraging not far apart on a lawn when suddenly, perhaps for no apparent reason, they fly to a near-by tree and facing each other with beaks open, as though with bared fangs, give this utterance.

To me, the basic *tsip* note is distinguishable in this peculiar series of notes. The utterance sounds something like this: *tss' tss' tss' tsurr tsurr tsurr*, starting with fast staccato notes and getting faster toward the end. Because these unique notes are given almost exclusively between birds of a mated pair, they are referred to in this study as mate-notes or as the mate-call.

The tendency to associate these notes with quarreling and fighting is not uncommon. For instance, Hoffmann (Birds of the Pacific States, 1927:315) states: "Two or more birds often squabble and utter a succession of squeaking and gurgling notes." Later in speaking of the Abert Towhee, he says that it "skulks and chips and quarrels with others of its kind with the same noisy, scolding splutter that the Brown Towhees give." To one who is not familiar with the territories of Brown Towhees, and who has not observed banded birds, the conclusion reached by Hoffmann may seem entirely correct. Although the mate-notes may be given at the moment of chasing and fighting, they are not, so far as can be determined, given between combatants, but rather by either one or both members of a pair doing the chasing. In other words, they are only incidental to the chase and have no direct bearing upon it.

Examples of pursuits or clashes, accompanied by mate-calls follow. Frequently, when a resident male pursued a bird to the edge of his territory, the resident female appeared by his side and the mate-call ensued. Often, early in the morning two pairs meet near the boundary between their territories, and the mates of each pair utter the mate-calls. Such a scene sometimes precedes a chase. For example, two pairs of towhees met (April 30, 5:45 a.m.) and gave their mate-calls almost simultaneously. There was a chase shortly afterward and then the resident pair returned toward their nesting shrubbery, voicing the mate-call again. In another instance (January 3; note date) a pair and a third bird were at the edge of a territory; the mate-call was given by one of the members of the pair and the third towhee was then chased a short distance. The members of the pair flew back to the shrubbery, where they had been roosting, and the mate-call was again given.

In most of these instances the meaning of the mate-call might have been misconstrued if the whole action was not carefully followed. In over a hundred recorded observations these mate-notes were given between members of a known pair when they met and in no instance did the two fight. Moreover, in approximately one hundred clashes or boundary disputes between birds of different pairs, no mate-call was given. Once, however, after a severe clash between two unmated males, the apparent winner flew to a vantage point and gave the mate-call. In this instance another bird, possibly a wandering female, had been present but had flown over the fence at the beginning of the combat and had disappeared. Whether or not the mate-call had relation to this bird, the call was given after the fight.

During the nesting season the mate-call is heard frequently throughout the day. The following instances will serve to show the range of situations under which the call is given. A male gave its mate-call as it flew into the shrubbery, but getting no response and not seeing its mate, it flew to another part of the shrubbery where the two met, giving the mate-call. Again, a female running with a leaf in her beak in pre-nesting activity, dropped it, and flew to join her mate at a window; the mate-call ensued. As a mated pair met in a tree, the mate-call was given; they then flew to the adjacent tree where they were building their nest. When the male, leaving the nest, meets his mate coming in with a load of food, the mate-call ensues.

A pair may give the mate-call at times of disturbance at the nest or when the safety of their fledglings is threatened. Once the writer put his hands into a nest which

held newly-hatched young. The female protested violently by *tsiping*, and then she and her mate flew from perch to perch voicing their mate-notes and chasing a Song Sparrow.

On rare occasions the mate-call is given under circumstances other than the meeting of mated birds. For example, a parent bird, disturbed when its fledgling was being stalked, at once gave an excited mate-call which appeared to spur the young to quick retreat. Such exceptions to the rule demonstrate the intense excitement which the call seems to connote.

In at least one instance the mate-call preceded copulation. One bird gave a loud *tsip* as it flew to a wire where it gave a mate-call. At once a second bird flew to the wire beside the first and two successive attempts at copulation ensued.

Outside of the nesting season the mate-calls are given less often. Before meeting in the morning, the members of a pair may forage separately for a while; when they meet, the mate-call is given. If birds of a pair have been separated as when being banded, the reunion brings an excited mate-call. Generally speaking, the mated birds forage together in the winter months and since the meetings are relatively fewer, the mate call is given less.

It is difficult to tell which sex gives the mate-call. Sometimes it appears that only one of the birds gives the call but more often it seems to be a duet. On several occasions it was clear that both members of a pair gave the notes. Once on February 6, a male lit in a big oak, giving the mate-call, and the female responded at once by flying from the ground and giving the mate-call herself. The female may initiate the call. For instance, a female flew down from an oak to a laurel shrub, giving a mate-call; the male flew to her side and hopped up to the top of the shrub where the mate-call was repeated. This was in the nesting season, on May 22.

The latter part of a mate-call is like a trill. When heard alone it may signify something different than the ecstatic greeting of mated birds. On March 11, an unmated male sang from the top of a leafless tree, then flew across the road into the territory of a mated pair. He came near the mated birds, posturing and uttering the singular mate-call trill. One of the birds, presumably the male, chased him away. However, for ten minutes or more the unmated bird stayed within twenty feet of the pair, and at least once again uttered this trill. Perhaps it was the awakening of the mate-call through the stimulus of a towhee of the opposite sex.

To summarize, the mate-call which is such a familiar part of the vocabulary of the Brown Towhee is almost invariably given between birds of a mated pair after they have been separated. The series of notes is given under a variety of conditions. Although it may be given at the time of a fight, it does not appear to be a fighting note, but rather a means of establishing or reinforcing the bond between members of a pair.

Eastern Oregon College of Education, La Grande, Oregon, March 10, 1941.

FROM FIELD AND STUDY

English Sparrow Eaten by Bullfrog.—One of the most interesting spots in our garden at Compton, California, is a pool inhabited by goldfish, two small turtles, and several frogs and toads, including two large bullfrogs of six and eight inches in length. Many hummingbirds, sparrows, warblers, and phoebes come to the pool to drink from the dripping water source or to bathe at its shallow end. The many water lilies and water hyacinths doubtless conceal the frogs from these birds.

One morning a commotion attracted me to the pool, where a few moments before a flock of English Sparrows (*Passer domesticus*) had been bathing. I was amazed to find that the smaller bullfrog had a female English Sparrow in its mouth. The frog submerged, but appeared again with the wings, tail, and legs of the unfortunate sparrow still protruding. After six minutes, it had succeeded (with great effort) in swallowing the entire sparrow except for the tips of the tail feathers.

Once before I had found in the pool the skeleton of a bird, lacking all flesh, but with the larger wing and tail feathers still attached. It puzzled me at the time, but I believe the above incident explains it as the regurgitated remnant of another bullfrog feast.—FRED H. W. LUEDERS, *Compton, California, January 5, 1941.*

MacFarlane Screech Owl in Harney County, Oregon.—A female MacFarlane Screech Owl (*Otus asio macfarlanei*) was taken by a local trapper in a steel trap set for mink near Ruby Spring on McCoy Creek in the Steens Mountains, Harney County, Oregon, on December 13, 1940. The bird was given to John C. Scharff of the Malheur National Wildlife Refuge, who had it preserved as a study skin. This is the first record of the occurrence of *macfarlanei* in Harney County coming to the writer's attention. The specimen is typical of the race as compared with specimens from other parts of eastern Oregon. Ruby Spring in the Steens Mountains is at about 4500 feet altitude, which is considerably higher than other localities where this bird has previously been taken in Oregon. The present specimen is being preserved in the bird reference collection at the Malheur Refuge.—STANLEY G. JEWETT, *Portland, Oregon, January 2, 1941.*

A New Record of the Semipalmated Plover in Nevada.—On May 5, 1940, while we were making a bird survey in the Truckee Meadows, about three miles southeast of Reno, Nevada, we noted a strange bird flying with three killdeer; it alighted near a small flock of feeding Least Sandpipers. The bird was about forty feet away, but by careful maneuvering, we managed to approach within fifteen feet of it. The single neck ring, stubby, black-tipped bill and orange legs left no doubt that the newcomer was a Semipalmated Plover (*Charadrius semipalmatus*).

This is the first record of this species in the Truckee Meadows, but it possibly is not as rare as might first be supposed. The species is recorded by Linsdale (*Pac. Coast Avif. No. 23, 1936:52*) from Smoke Creek, Washoe County, where Streater took a male on May 11, 1896. Grater (*Condor, 41, 1939:221*) reported two individuals from Lake Mead, near the site of the abandoned town of St. Thomas, Clark County, on May 7, 1938.—GLEN CHRISTENSEN and THOMAS TRELEASE, *Reno, Nevada, February 10, 1941.*

Nesting of Band-tailed Pigeons at Altadena, California.—In the past fifty years I have frequently seen flocks of Band-tailed Pigeons (*Columba fasciata*) in the fall and winter feeding on the acorns at my home in Altadena, Los Angeles County, California. Not until 1933 did I notice pigeons nesting or staying here throughout the year. The elevation at Altadena is 1000 feet and the distance from the nearest regular nesting place known to me, on Mount Wilson, is about one and a half miles. There are many live oaks and Englemann oaks on and around my place.

In 1933 one pair of pigeons was seen frequently from May to September but no nest was found. In 1934 one pair was seen frequently from April to August and in July a nest was found and a dead young pigeon on the ground under it. I have no record for 1935.

In 1936 pigeons were seen feeding young on July 4, incubating on July 7, and building a nest on August 25. This latter nest was deserted a few days later.

In 1937 a pigeon was seen on March 19 sitting on a last year's nest, which it apparently deserted later. At least one pair was seen about all summer. On October 6 a nest was found with a young bird. This young one was raised and left the nest on November 1.

In 1938 at least two pairs were seen around all summer. On August 8 I found a pigeon incubating. The young bird left the nest September 11. On September 12 five pigeons were seen, two of which were young.

In 1939 a pair was seen building a nest on February 27. On April 1 I found a dead young bird

under this nest. On March 15 two birds were found incubating. On April 18 these two nests were still occupied, but I could not see what was in them. On April 22 ten pigeons were seen together on the telephone wire, some of them apparently young birds. On May 12 a pair was seen building, and the young bird left this nest on June 24.

In 1940, on May 20, a pigeon was found sitting, this being the third successive year that this nest was used. On July 15 several pairs were about, one of which was feeding young. On July 20 I found a nest with a young bird, which left the nest on July 29. On July 31 a pair was building, and later sitting; but after a few days they deserted. On September 2 I found a pigeon incubating, and the young bird subsequently was raised. On October 5 I found a nest, with the bird incubating; the juvenile was still in the nest on October 27.

All of these nests were in oak trees, from fifteen to thirty-five feet above the ground and mostly inaccessible. I am told on good authority that pigeons have nested in San Marino, Los Angeles County, in recent years and also near Covina. A young pigeon fell from a nest in the southwest part of Pasadena about July 1, 1940, and was raised by hand and released by me. The earliest date of nesting was on February 27, 1939, when a nest was being built, and the latest, November 1, 1937, when a young bird left the nest. As far as I know there has not been more than one egg in each nest and the proportion of successful nestings has been small.—WALTER I. ALLEN, *Altadena, California, February 13, 1941.*

Additional Records of the Western Mockingbird in Oregon.—On July 25, 1940, while the author and Mr. Forrest Carpenter were assisting in taking the monthly bird census on the Malheur National Wildlife Refuge, Oregon, a Western Mockingbird (*Mimus polyglottos*) was observed at the south end of "Big Sagebrush Field" in unit 10. The following day Mr. John C. Scharff observed what probably was the same individual near the place where it was noted the day before.

In the course of the next monthly census, on August 23, another mocker was seen at "Grain Camp Dam" in unit 6 by the author and Mr. R. M. Tullar. Also, Mr. Groves of the refuge staff reported that the day before a mockingbird (evidently the same bird) lit on a hay rack he was preparing to load in the grain field just east of the dam.

Previous to these records a group of ornithologists from La Grande, Oregon, while visiting the refuge in the latter part of May, reported seeing a Western Mockingbird in Burns (Hyde, Condor, 42, 1940:305). Gabrielson and Jewett (Birds of Oregon, 1940:462) cite five records from the Steens Mountains and the Blitzen Valley, and recorded the bird as rare.—CLARENCE A. SOOTER, *Fish and Wildlife Service, Burns, Oregon, December 26, 1940.*

Prairie Falcon Parasitizing a Marsh Hawk.—About 1:15 p.m., on January 27, 1941, while driving on the highway from Benicia toward Cordelia, Solano County, California, about two and one-half miles south of the latter place, Mrs. Parmenter and I saw a Marsh Hawk (*Circus hudsonius*) take a Coot (*Fulica americana*) from the surface of the water. When abreast of us, it dropped the coot and at that instant we saw that the hawk was being pursued by a Prairie Falcon (*Falco mexicanus*).

As the Marsh Hawk dropped the coot, the falcon landed on the ground where the coot had fallen, it having caused the hawk to drop its prey. The hawk continued its flight, leaving the falcon at the dropped coot. The Marsh Hawk returned shortly, accompanied by a second hawk, and the two drove off the falcon. The two hawks remained at the spot only a short time and then flew off to the northward. The falcon in a few minutes returned to the spot and we had a perfect view of it with our binoculars.

On our return home we consulted various sources in our literature concerning the Prairie Falcon. In Fisher's Hawks and Owls (U. S. Dept. Agriculture, Div. Orn. and Mamm., Bull. 3, 1893:104) is a quotation from Ridgway: "Late in November, of the same year [1867], . . . [the Prairie Falcon] was noticed again among the marshes along the Carson River [Nevada], near Genoa, where it was observed to watch and follow the Marsh Hawks (*Circus hudsonius*), compelling them to give up their game which was caught by the Falcon before it reached the ground; this piracy being not an occasional, but a systematic habit."

Decker and Bowles (Auk, 47, 1930:25-31), state that "a large female [Prairie Falcon] at Santa Barbara, California, had killed a Coot (*Fulica americana*) with which it tried to fly across the road." This shows that Prairie Falcons are not averse to taking a coot occasionally. Most authorities agree that the Marsh Hawks frequently take water birds and wounded ducks.

In the twelve miles from Benicia to Cordelia we saw about seventeen Marsh Hawks. New moon occurred that day and accordingly there was a six-foot tide. Because of this and the fact that the numerous fields were covered as a result of the previous rains, conditions were ideal for the Marsh Hawks in their search for food.—HENRY E. PARMENTER, *San Francisco, California, February 14, 1941.*

Scarlet Tanager at Boulder, Colorado.—Although there have been several published reports of the Scarlet Tanager (*Piranga erythromelas*) in Colorado, it seems desirable to place on record an additional observation which recently was made. The previous records are all of some years back, no records later than those summarized by W. L. Sclater (A History of the Birds of Colorado, London, 1912: 410-411) having been found by the writer in a survey of the literature. The record of this species in California (Miller and Miller, Condor, 32, 1930:217) is, of course, much more remarkable than a Colorado record. Nevertheless, the last Colorado record seems to have been in 1904, and the only previous observation for the Denver-Boulder area is based on a specimen said to have been collected by E. L. Berthoud near Golden in 1867.

On May 8, 1940, Elliot Miller and Owen France, two students in ornithology at the University of Colorado, reported a male Scarlet Tanager on the University campus at Boulder. The bird was seen by me on the same day. It remained among the small trees and shrubs about a pond quite near the biology building for three days, being seen on May 8, 9, and 10. It was not reported after the latter date. Many students, including all members of my class in ornithology, and several faculty members observed the bird at close quarters. It was in the brilliant plumage of the fully mature male, and there was no question of its identification. It appeared perfectly normal in behavior. No attempt was made to collect the bird.—GORDON ALEXANDER, *Department of Biology, University of Colorado, Boulder, Colorado, March 17, 1941.*

Mountain Plover in Solano County, California.—On November 12, 1939, Mr. Gunnar Larson and I were hunting jack rabbits in dry pasture land near Cannon, a flag station on the Southern Pacific Railroad, six miles northeast of Suisun, Solano County, California. The fields, because of long lack of rain, were almost entirely denuded of vegetation, leaving little cover for rabbits or any wild life.

Killdeer (*Oxyechus vociferus*) were common, and after we had tramped about for awhile it occurred to me that plover of another species than Killdeer were present. Small groups of four to ten birds reluctantly flushed from the ground at my approach, passing me with a sort of grunting sound and lit not far distant. Taking my field glasses I found that there were about eighty of these birds scattered about and feeding in one part of the large open field. I had not previously met with Mountain Plover (*Eupoda montana*) outside of my ornithological library, but I suspected that they were of this species. I took one specimen for my collection of skins and subsequently went back to the field about an hour later and took another specimen for the Museum of Vertebrate Zoology in Berkeley, where it has been given number 77275.

Upon skinning the plovers both were found to be females. The stomach of one held ten mandibles and other parts of Jerusalem crickets (*Stenopelmatus*), and the other held forty-six mandibles and other portions of *Stenopelmatus* and fragments of two or three small black beetles.—EMERSON A. STONER, *Benicia, California, November 20, 1939.*

The Rocky Mountain Creeper in California.—While doing some field work on February 9, 1939, in the lower valley of the Colorado River, Riverside County, California, the writer took a male creeper in the cottonwoods of the river bottom.

Later, while comparing the specimen with other skins in the collection of the Los Angeles Museum, in company with George Willett, it was found that the specimen resembled most closely skins of the Rocky Mountain Creeper (*Certhia familiaris montana*). Some time later the bird was sent to the late Joseph Grinnell of the Museum of Vertebrate Zoology, who agreed with Mr. Willett's and the writer's findings.

Dr. Grinnell also stated that the specimen constituted the first authentic record for the state, as all prior records have been disproven. This bird is now in the collection of Dr. Max M. Peet, Museum of Zoology, University of Michigan.—KENNETH E. STAGER, *Los Angeles, California, February 26, 1941.*

Some Birds Recorded in Nuevo León, Mexico.—The 136 forms of birds recorded in Nuevo León between January 27 and March 6, 1938, in the course of the first John B. Semple Expedition to eastern Mexico, have already been reported on (Sutton and Burleigh, Occas. Papers Mus. Zoology, Louisiana State University, no. 3, 1939:1-46). These 136 forms include most of the winter birds of the Monterrey district.

In 1939, Mr. Semple and the authors visited Nuevo León somewhat later in the season, and as a result encountered several transient- and summer-resident species not seen the previous year. They collected on the Mesa de Chipinque (3500 to 7000 feet) on March 17 to 21, near Monterrey (1500 feet) on March 21 and 22, and at Linares (a point not visited in 1938) on March 22 and 23. The following list includes only the most noteworthy of the more than one hundred forms encountered in Nuevo León that season.

Accipiter striatus suttoni. Mexican Sharp-shinned Hawk. On March 18, a female of this plain-breasted race was collected on the Mesa de Chipinque not far from the spot where the type was taken the previous year. The specimen is in perfect breeding plumage, and it is interesting to note how, in comparative immaculacy of the reddish underparts (especially the flaps), it differs radically from female *velox*. The upper parts are not nearly so blue-gray as in the male type, but brownness of upper parts apparently is characteristic of the adult female throughout all the races of *Accipiter striatus*. As in the type, the eyes were deep brown, not red or orange-red. Measurements: wing, 222 mm.; tail (slightly furcate rather than square), 176; tarsus, 61. Sharp-shinned Hawks with unbarred underparts were seen several times in the plains country about Monterrey, as well as on the Mesa de Chipinque.

Amazona viridigenalis. Red-crowned Parrot. Large flock seen at Linares, March 22. Not noted north of the vicinity of Victoria, Tamaulipas, in 1938.

Otus asio semplei. Semple Screech Owl. A topotypical gray female specimen of this race was taken on the Mesa de Chipinque on March 17. The following day a male in red phase of plumage was captured at the same place (Semple). A male *Otus asio* taken at Linares on March 22 (Sutton) is not so dark on the crown as the gray-phase specimen from the Mesa.

Bubo virginianus mayensis. Mayan Horned Owl. According to Ridgway and others, the horned owl of Nuevo León is *B. v. pallascens*. A breeding male, found dead along the highway on March 23, near the Nuevo León-Tamaulipas state line is, however, of this small, grayish, speckled-footed subspecies. The wing measures 318 mm. (primaries not pressed flat), the tail 189.

Glaucidium gnoma gnoma. Pygmy Owl. Male in "grayish-brown" phase taken on Mesa de Chipinque, March 18 (Burleigh). Another Pygmy Owl, noted the following day, was mobbed by small birds. This presumably non-migratory species was not seen in 1938.

Selasphorus platycercus. Broad-tailed Hummingbird. Noted repeatedly about rock slides and talus slopes on Mesa de Chipinque. Courting male taken March 18 and female taken March 20 (Sutton). Not recorded in 1938, hence probably does not winter there.

Eugenes fulgens fulgens. Rivoli Hummingbird. Female taken at about 6000 feet on Mesa de Chipinque, March 20 (Burleigh). Not seen in 1938.

Trogon ambiguus ambiguus. Coppery-tailed Trogon. Noted repeatedly on the Mesa, where it evidently was preparing to nest. Male taken March 18 (Burleigh). Not recorded at all in 1938, hence presumably does not winter there.

Ceophloeus lineatus. Lineated Woodpecker. Noted at Linares, March 22 and 23. According to Peters (Occas. Papers Boston Soc. Nat. Hist., 5, 1930: 318) the most northward-ranging race of this species, *C. l. leucopterylus*, occurs in "southern Tamaulipas and probably adjacent portions of San Luis Potosí, Nuevo León and Vera Cruz." Our sight records establish the fact that *lineatus* occurs in eastern Nuevo León where there is heavy timber.

Myiarchus tuberculifer lawrencei. Lawrence Dusky-capped Flycatcher. Noted several times on the Mesa de Chipinque, where males were taken March 18 and 19 (Burleigh). Not recorded in 1938.

Myiarchus cinerascens cinerascens. Ash-throated Flycatcher. Male taken near Monterrey, March 21 (Burleigh). Not seen north of Victoria, Tamaulipas, in 1938.

Empidonax difficilis hellmayri. Hellmayr Western Flycatcher. Noted repeatedly on the Mesa de Chipinque (4500 to 7000 feet), where males were taken March 17 to 20 (Sutton). Not recorded in 1938, hence presumably a migratory form.

Myiochanes pertinax pallidiventris. Coues Flycatcher. Male taken on the Mesa de Chipinque, March 18 (Burleigh). Not noted north of Gómez Farias, Tamaulipas, in 1938.

Corvus imparatus. Mexican Crow. Seen repeatedly in vicinity of Linares, March 22 and 23, but not to the north of this district.

Certhia familiaris montana. Rocky Mountain Creeper. Noted on the Mesa de Chipinque March 18 and 19, where two females were collected on the latter date (Burleigh). Not noted in 1938.

Dendroica chrysoparia. Golden-cheeked Warbler. Noted several times on the Mesa de Chipinque, where a male and a female were collected March 19 (Sutton). The gonads in these specimens were somewhat enlarged. There was no evidence of prenuptial molt, the plumage being somewhat worn. This species was not seen in 1938, so presumably it does not winter in the Monterrey region.

Setophaga picta picta. Painted Redstart. Common, March 17 to 20. Noted February 9 to 14, in 1938, when it was considered "decidedly uncommon."

Icterus cucullatus cucullatus. Hooded Oriole. Contrary to current concept, this bird must be somewhat migratory. We did not see it anywhere north of Victoria, Tamaulipas, in the course of our 1938 investigations, but recorded it repeatedly on March 21 and 22, near Monterrey in 1939, presumably at about the time it returns to its nesting grounds.

Icterus parisorum. Scott Oriole. Two males were taken on the Mesa de Chipinque, March 18. Not noted in 1938.

Piranga bidentata sanguinolenta. Lafresnaye Tanager. Male taken on Mesa de Chipinque, March 19 (Burleigh). Not noted in 1938.

Ammodramus savannarum perpallidus. Western Grasshopper Sparrow. Female (wing, 63 mm.; tail, 45) taken near Monterrey, March 21 (Burleigh). This is *A. s. bimaculatus* of the A. O. U. Checklist. (For change of name, see Auk, 51, 1934:549.) The Grasshopper Sparrow was recorded in 1938 only at Victoria, Tamaulipas, a specimen of the eastern race (*pratensis*) being taken that year on February 24.

Aimophila cassinii. Cassin Sparrow. Noted repeatedly about Monterrey on March 21 and 22; males were in full song at that time. Not seen in 1938; but this hardly proves that it winters south of Monterrey for it is an exceedingly inconspicuous bird when not singing.—GEORGE MIKSCH SUTTON and THOMAS D. BURLEIGH, *Cornell University, Ithaca, New York, November 19, 1940*.

Barn Owls Nesting at Kanab, Utah.—Of late, while perusing the literature pertaining to Utah birds, I have noted the scarcity of records of the Barn Owl (*Tyto alba*) for the state, and especially the absence of breeding records. Indeed, I have found the species listed only three times. Tanner (Condor, 29, 1927:198) stated that he had collected the bird in March in the St. George area but that they were not common. Presnall (Proc. Utah Acad. Sci. Arts and Letters, 12, 1935:201) gives its status as rare for Zion National Park. Hardy and Higgins (Proc. Utah Acad. Sci. Arts and Letters, 17, 1940:99) record the owl as having been seen by them on April 19, 1939, and March 16, 1940, at St. George. It seems advisable, therefore, to place on record data pertaining to breeding Barn Owls collected recently at Kanab, in Kane County, central southern Utah.

Mr. Clifton M. Greenhalgh has observed Barn Owls in the vicinity of Kanab for many years and has found them inhabiting caverns in the banks of Kanab Creek near the town. In the spring of 1939 he brought me a quantity of pellets, but he was unable to secure a specimen. On June 14, 1939, Dr. A. M. Woodbury, acting on Greenhalgh's directions for finding the birds, secured a specimen, now number 5684, Mus. Zool. University of Utah. Then in July, 1940, Mr. Greenhalgh secured two additional specimens from Kanab. Number 5813 is a male taken July 12, 1940, two miles south of Kanab at 4600 feet; number 5814, also a male, was secured at the same place on July 10, 1940. This latter specimen is a juvenile, as indicated by some natal down feathers adhering to the tips of the juvenal feathers.

In all probability, the distribution of Barn Owls in the state is confined to the southern portion where Lower Sonoran or near Lower Sonoran conditions prevail. Nesting and roosting in cavities in mud banks formed by water seepage is an interesting adaptation to local conditions. According to Mr. Greenhalgh, the Barn Owls nest and roost only in one area along about a mile of Kanab Creek where there is an abundance of caverns and side washes and where the main gulley is in places as much as 40 feet deep. The Barn Owls are presumably summer residents, arriving sometime in April at which time pairs seek out small caverns for individual nesting sites. Later on, at the termination of the nesting season, they display a gregarious tendency and congregate, at least in daylight hours, in the larger caverns. Here they come to rest on dirt ledges in the darkest portions. As many as 30 Barn Owls assembled together have been noted by Mr. Greenhalgh under these conditions.—WILLIAM H. BEBLE, *University of Utah, Salt Lake City, January 15, 1941*.

California Cuckoo in Southeastern Nevada.—In Linsdale's "Birds of Nevada" (Pac. Coast Avif. No. 23, 1936:61) reference is made to the occurrence of the California Cuckoo (*Coccyzus americanus occidentalis*) along the Lower Truckee River and in the Pyramid Lake region of Nevada. Because of the relatively few records of this bird in this state, it seems appropriate to record that the writer observed a cuckoo in the town of Alamo, Clark County, Nevada, on August 28, 1940. The bird was observed in a cottonwood tree about 30 feet from the ground.—CLARENCE COTTAM, *Fish and Wildlife Service, Washington, D. C., December 2, 1940*.

Another Summer Record of the Great Gray Owl in Yellowstone National Park.—The recent note by W. S. Long (Condor, 43, 1941:77-78) recording a sight observation of the Great Gray Owl (*Scotiapteryx nebulosa*) in Yellowstone National Park stimulates me to place the following observation on record. On September 9, 1940, at about 3:45 p.m., I saw one of these owls in a meadow between West Thumb and Old Faithful, Yellowstone Park, at a place that must have been very close to the location at which Long made his observation on July 3. The bird I saw was perched on top of a lodgepole pine stub about twelve feet high and only thirty feet from the highway. The bird

was facing the road obliquely in the direction from which automobiles approached on the near side, but the approach of our car from the opposite direction caused it to turn its head slightly toward us. The owl was not seen when we drove back about seventy minutes later. Like the day described by Long, September 9 was cloudy, with a heavy drizzle in the morning. It seems entirely possible that the same owl had remained in this limited area for most or all of the summer.—FREDERICK H. TEST, Department of Zoology, University of Michigan, Ann Arbor, Michigan, February 5, 1941.

Bird Notes from Lassen Volcanic National Park.—Since the publication in 1930 of the "Vertebrate Natural History of a Section of Northern California through the Lassen Peak Region," (Univ. Calif. Publ. Zool.) by Grinnell, Dixon, and Linsdale, further observations on birds have been made, chiefly in the more limited area of Lassen Volcanic National Park proper. The report of 1930 dealt with a strip 24 miles wide and 124 miles long, extending from west of the Sacramento River nearly to the Nevada line, and with elevations from less than 300 feet to 10,453 feet. Approximately in the middle of the strip is Lassen Park, which is about 12 miles wide and 17 miles long, with elevations of from 5250 feet in Warner Valley to 10,453 feet on Lassen Peak.

Except as otherwise noted, the following observations were made by the writer in the period from 1937 to 1940. Specimens mentioned are in the park collection at Manzanita Lake; these were identified at the Museum of Vertebrate Zoology. Species not recorded by Grinnell, Dixon, and Linsdale for the park itself are marked with an asterisk. Acknowledgment is made to Dr. Carl R. Swartzlow, Merlin K. Potts, and Joseph S. Dixon of the National Park Service, for assisting with this report.

**Colymbus nigricollis californicus*. American Eared Grebe. From one to seven were seen at various times in September and October of 1939 and 1940, at Manzanita Lake and Snag Lake. Also seen by Merlin K. Potts at Butte Lake, November 7, 1939.

**Podilymbus podiceps podiceps*. Northern Pied-billed Grebe. Seen by Potts at Summit Lake, November 6, 1938, and at Butte Lake, November 8, 1938. Also seen in September and October, 1938-39, and July-October, 1940, at Manzanita Lake; and on September 20, 1940, at Hat Lake. In September, 1940, 2 adults with 6 young were seen on Manzanita Lake. The number of adults otherwise seen was usually one or two.

Pelecanus erythrorhynchos. American White Pelican. One was observed at Manzanita Lake from August 20 until September 11, 1939.

**Phalacrocorax auritus albociliatus*. Farallon Double-crested Cormorant. Seen from August until October, 1938-40, on several of the larger lakes of the park. One to three commonly seen on lakes in the north and east parts of the park.

Ardea herodias hyperonca. California Great Blue Heron. Frequently observed at Manzanita Lake; and seen as early as June 3 and as late as November 16 (1940). Also seen at Summit and Butte lakes, in September of 1939 and 1940.

**Casmerodius albus egretta*. American Egret. What was thought to be a breeding pair was observed at Manzanita Lake from July to September, 1936, by C. R. Swartzlow. A single individual was seen twice in September, 1940, in Upper Kings Meadow, about three miles southeast of Lassen Peak.

**Botaurus lentiginosus*. American Bittern. One individual was seen at Manzanita Lake, August 13, 1940.

**Cygnus columbianus*. Whistling Swan. Fifteen were seen on Manzanita Lake, November 9, one on the 13th, and one on the 16th, 1940.

Branta canadensis canadensis. Canada Goose. Numerous at Manzanita Lake and Snag Lake in September and October, each year. Also seen on other lakes in the park. Commonly seen and heard flying over Manzanita Lake region on southward migration. On October 18 and 19, 1940, about 1000 were seen during the day, flying south in V-formations of 15 to 100 each.

Anas platyrhynchos platyrhynchos. Common Mallard. Most common duck in the park. Seen on lakes throughout the park in September and October. Three or more broods raised at Manzanita Lake each summer, May-August. They are tame during the summer, but wild after about September 15.

**Mareca americana*. Baldpate. In November, 1939, as many as 30 were seen on Manzanita Lake by Potts and Swartzlow. Potts observed 16 on Summit Lake on November 16. In 1940, 12 or more were present on Manzanita Lake during late October and November.

**Aix sponsa*. Wood Duck. A female was observed on Hat Lake, November 6-7, 1938, by Potts. On October 26, 1939, a pair was observed feeding along the shore of Reflection Lake.

**Nyroca collaris*. Ring-necked Duck. Observed by Potts at Summit and Butte lakes in November, 1938; 65 were on Summit Lake.

**Nyroca americana*. Redhead. A flock of 15 was seen at Butte Lake on November 8, 1938, by Potts.

**Nyroca valisineria*. Canvasback. A flock of seven was seen on Butte Lake, November 22, 1938, by Potts.

**Nyroca affinis*. Lesser Scaup Duck. A flock of five males and ten females was seen on Reflection Lake, November 16, 1940.

**Charitonetta albeola*. Buffle-head. Two females were seen on Manzanita Lake, by Potts, from November 6 to 12, 1939.

**Accipiter velox*. Sharp-shinned Hawk. Seen infrequently at Manzanita Lake, Lassen Peak, and a few other places in the park, in July and August.

Haliaeetus leucocephalus leucocephalus. Southern Bald Eagle. Seen several times at Snag Lake in September, 1937.

**Circus hudsonius*. Marsh Hawk. Seen occasionally at Kings Meadow in July and August. Seen in devastated area in August, 1940, by G. O. Hale. One seen at Manzanita Lake, November 9, 1940.

Oreortyx picta picta. Interior Mountain Quail. Seen at Manzanita Lake, 6000 feet, as late as November 7, 1940, after several snow storms.

**Fulica americana americana*. American Coot. This species is now the most common water bird in the park during September and November. More than 200 were seen on Snag Lake, September 29, 1940, and about 300 were present on Manzanita Lake in October and November of the same year. Two were on the latter lake from June to September, 1940.

Capella delicata. Wilson Snipe. One was seen at Manzanita Lake in September, 1940.

Columba fasciata fasciata. Northern Band-tailed Pigeon. A small flock was seen near Butte Lake in September and October, 1937.

Bubo virginianus pacificus. Pacific Great Horned Owl. Frequently observed at Manzanita Lake from June to November (1938-1940); observed at Summit Lake in July and August (1939-1940).

Phalaenoptilus nuttallii californicus. Dusky Poor-will. Seen from July to September in 1939 and 1940, near Summit Lake. Observed twice by Potts in August, 1940, near Diamond Peak.

Chordeiles minor hesperis. Pacific Nighthawk. Common in June and August (1937-1940), at Manzanita Lake.

**Megaceryle alcyon caurina*. Western Belted Kingfisher. Frequently seen along streams and lakes throughout the park, at least from May until November (1938-1940).

**Aphelocoma californica immanis*. Interior California Jay. Single individuals were seen twice, in September and October, 1939, at Manzanita Lake. In September, 1940, several individuals were observed several times at Manzanita Lake and once at Hat Lake.

Nannus hiemalis pacificus. Western Winter Wren. Recorded by Potts at Park Headquarters, Mineral, on December 27, 1939.

**Ixoreus naevius meruloides*. Northern Varied Thrush. Two were seen twice in October, 1939, at Manzanita Lake. In October, 1940, two were seen two miles east of Lassen Peak, 6500 feet; and single individuals or pairs were seen commonly near Manzanita Lake. One specimen was taken from here.

Anthus spinoletta rubescens. American Pipit. Seen at Lake Helen, 8200 feet, September 16, 1939; Lassen Peak, 9000 feet, October 28, 1939, and July 1, 1940. One seen by Potts at Butte Lake, October 28, 1939. Three seen in the Caribou Peak primitive area, east of the park, near Silver Lake, Lassen County, August 1, 1940.

**Spinus tristis salicamans*. Willow Goldfinch. One seen October 18, and (probably the same one) collected October 27, 1939, at Manzanita Lake, 5845 feet. The highest previous record known to the writer is of two specimens taken by J. M. Willard from near Eagle Lake, Lassen County, 5100 feet, October 12, 1899 (Grinnell, Dixon, and Linsdale).

**Pipilo maculatus*. Spotted Towhee. In September and October, 1939, this species was seen at several places in the park, from Manzanita Lake, 5845 feet, to East Lake, 7100 feet, and Cliff Lake, 7300 feet. It was most common in the chaparral of manzanita and tobacco brush (*Ceanothus velutinus*), near Manzanita Lake. From September 15 to October 15, 1940, it was common in the same vicinity.

**Passerella iliaca fuliginosa*. Sooty Fox Sparrow. One collected on October 23, 1939, at Manzanita Lake.—JULIAN VOGT, Lassen Volcanic National Park, Manzanita Lake, California, March 20, 1941.

NOTES AND NEWS

The fifty-eighth meeting of the American Ornithologists' Union will be held in Denver, Colorado, September 1 to 4, 1941.

A noteworthy paper, likely to be overlooked, is that by R. W. Fautin (*The Great Basin Naturalist*, 1, January 28, 1940:75-92) on territorial behavior of the yellow-headed blackbird in Utah.

MINUTES OF COOPER CLUB MEETINGS

NORTHERN DIVISION

JANUARY.—The regular monthly meeting of the Northern Division of the Cooper Ornithological Club was held on Thursday, January 23, 1941, at 8:00 p.m., in Room 2503 Life Sciences Building, Berkeley, with E. Lowell Sumner, Jr., presiding, and some 60 members and guests present. The minutes of the Northern Division were read, and, with one correction, were approved. Names proposed for membership were: Glen Christensen, 513 University Ave., Reno, Nevada, by Hilda W. Grinnell; William G. George, 257 North Branciforte Ave., Santa Cruz, California, by Alden H. Miller and Clark P. Streater; and Rhoda Huffman, Box 75, Fair Oaks, California, by Lloyd G. Ingles.

Alden H. Miller read the slate of officers drawn up by the nominating committee; they were, E. Lowell Sumner, Jr., President; Richard Bond, Vice-president; Hilda W. Grinnell, Corresponding Secretary; Frances Carter, Recording Secretary. Nominations were asked for from the floor but none were made. On motion by Bert Harwell the secretary was instructed to cast an unanimous ballot for the officers as proposed.

Mr. Brighton Cain announced the publication of "Texas Bird Adventures" by Herbert Brand.

Mr. Bert Harwell gave a brief outline of the history of the Audubon Society, especially covering recent expansion of its activities on the Pacific Coast.

Field notes covered many parts of the West and a large number of species. Charles Sibley told of the birds seen in the lower Colorado River region while on a collecting trip with John Davis and John Chattin, December 20 to January 15. Mr. Sibley obtained a Least Bittern and a Sora Rail that had been caught in muskrat traps. He also reported a Slate-colored Junco collected in Berkeley, January 18, 1941. Joe Marshall reported seeing Ring-necked Ducks on San Pablo Reservoir. Frank Watson reported seeing over one hundred American Mergansers on San Pablo Reservoir on January 19. Milton Seibert reported seeing Lincoln Sparrows near Mills College within the past week. The mention of Saw-whet Owls served to stimulate a discussion of the range in pitch

of bird songs, during which Mr. Harwell gave imitations of some of the Yosemite birds.

Adjourned.—THOMAS L. RODGERS, *Acting Secretary*.

FEBRUARY.—The regular monthly meeting of the Northern Division of the Cooper Ornithological Club was held on Thursday, February 27, 1941, at 8:00 p.m., in Room 2503 Life Sciences Building, Berkeley, with President E. Lowell Sumner, Jr., in the chair and about 65 members and guests present. Minutes of the Northern Division for January were read, corrected and approved. Minutes of the Southern Division were read in part. Names proposed for membership were: Dr. Floyd B. Chapman, U. S. Fish and Wildlife Service, 1140 Park Square Building, Boston, Massachusetts, by George Tonkin; Mr. Beverly Harry, 6417 Dana Street, Oakland, California, by John T. Emlen, Jr.; Elsie Sorrell (Mrs. Thomas L. Sorrell), R.F.D. No. 1, Calistoga, California, by Bert Harwell.

Joe T. Marshall, Jr., spoke on the Song Sparrows of the salt marshes of San Francisco Bay. He indicated the characteristic differences in coloration between the birds of the upland regions and those of the salt marsh habitats. In reviewing the history of the problem, he quoted extensively from the notebook of Joseph Grinnell, describing the bird populations at the mouth of San Francisco Creek, near Palo Alto, in 1900.

Adjourned.—FRANCES CARTER, *Recording Secretary*.

SOUTHERN DIVISION

DECEMBER.—The monthly meeting of the Southern Division of the Cooper Ornithological Club was held at the Los Angeles Museum on Tuesday, December 17, 1940, with Vice-president Hildegard Howard in the chair and 16 members and guests present.

The minutes of the November meeting of the Southern Division were approved as read.

Dr. Howard appointed as a nominating committee for 1941 the following: Howard Robertson, Chairman, W. Lee Chambers and Loye Miller.

Mr. S. D. Platford reported that while visiting the State Waterfowl Refuge at Calipatria, south of the Salton Sea, in company with Luther Goldman and A. W. Elder, a flock of about sixty Whistling Swans flew in from the southeast and settled on the main pond at about noon on Sunday, December 8, 1940. They also observed 300 White-faced Glossy Ibis about 3 miles south of the refuge, many egrets, a pair of Yuma Rails and 143 Sandhill Cranes.

Observations by W. W. Bennett, George Wil-

lett and S. D. Platford revealed the occurrence of Northern, Red and Wilson phalaropes in the vicinity of Los Angeles until December. Mr. Kenneth Stager reported that his brother observed many yellow flickers in yellow pines near Fraser Mountain, Ventura County, and later he, himself, observed Williamson Sapsuckers, Piñon Jays and a Mt. Pinos Grouse there. In the White and Argus mountains in Owens Valley, he reported that the Inyo Screech Owl lives in flicker holes of old cottonwoods and he recently located 4 owls in 69 holes examined.

Mr. George Willett reported that apparently three non-native doves exist at present in the vicinity of Los Angeles, the Ringed Turtle Dove, which is confined to some parks, the Crested Dove, and the Chinese Spotted Dove. The latter bird appears to have been voluntarily released about 1917 and now exists in considerable numbers in parks and gardens. The Chinese Spotted Dove, according to Mr. Willett, has spread naturally as far as Pomona and has been released in the vicinity of Palm Springs by the Fish and Game Commission. Mr. C. O. Reis reported that a dove fancier on New Hampshire Avenue near the old U. C. L. A. campus released a flock in about 1918 when he sold his property to the state. Dr. Hildegard Howard observed Chinese Spotted Doves nesting on the campus in 1924. Dr. H. N. McCoy reported that the flock of Ringed Turtle Doves at Westlake Park disappeared when a new highway was constructed through the park, but Mr. S. D. Platford reported they still could be seen at Pershing Square.

Eastern Cardinals were reported from San Gabriel Canyon by Bert Harwell; from San Diego, Hollywood, and Altadena by George Willett; they were reported breeding for several years at Bel-Air by Kenneth Stager. Mr. W. W. Bennett stated that since their appearance in northern Iowa in the 1890's they have extended their range into northern Minnesota and Canada.

Adjourned.—SHERWIN F. WOOD, *Secretary*.

JANUARY.—The regular meeting of the Southern Division of the Cooper Ornithological Club was held at the Los Angeles Museum, on Tuesday, January 28, 1941, with President Robert T. Moore in the chair, and 200 members and guests present.

The minutes of the December meeting of the Southern Division were approved as read.

The names of the following persons were proposed for membership: Robert Hunter, Jr., The Meadow Ranch, Red Bluff, California, James Grant, Jr., Trinity Valley, Lumby P. O., British Columbia, Canada, and Maynard Fosberg, Rt. 2, Box 313, Turlock, California, by Mrs. N. Edward Ayer; Clark C. Van Fleet, 1833 SE. Exeter Drive, Portland, Oregon, William F. Rapp, Jr., 130

Washington Avenue, Chatham, New Jersey, (Edward) Gordon Alexander, Department of Biology, University of Colorado, Boulder, Colorado, and Robert Vernon Reynolds, 1842 San Antonio, Berkeley, California, by W. Lee Chambers; Miss Josephine Conly Smith, 1749 E St., Apt. No. 104, San Bernardino, California, by John McB. Robertson; Miss Benita Hudson, 250 North Cañon Drive, Beverly Hills, California, by Mrs. Irene Sebastian; Howard P. Davis, 2608½ West Ramona Blvd., Alhambra, California, by George Willett; Ralph M. Crumrine, M.D., Centinela Hospital, Inglewood, California, by Sherwin Wood.

The President called for a report of the nominating committee and Chairman Howard Robertson proposed for President, Hildegard Howard; for Vice-president, Sherwin F. Wood; and for Secretary, Irwin D. Nokes. There being no further nominations, these persons were elected by unanimous ballot.

President Howard then presented the speaker of the evening, Mr. Ed N. Harrison of Encinitas, California, who displayed a motion picture taken by himself and J. R. Pemberton, all in color, of a trip made last April in Mr. Pemberton's yacht to some islands off the coast of Lower California. The entire picture, lasting nearly two hours, was filled with interest and instruction and was beautiful beyond description. At the close of the entertainment, the audience gave hearty expression of thanks for the pleasures they had enjoyed.

Adjourned.—IRWIN D. NOKES, *Secretary*.

FEBRUARY.—The regular monthly meeting of the Southern Division of the Cooper Ornithological Club was held at the Los Angeles Museum on Tuesday, February 25, 1941, with President Hildegard Howard in the chair, and about 80 members and guests present.

The minutes of the January meeting of the Southern Division were approved as read.

The names of the following persons were proposed for membership: Gordon M. Meade, Strong Memorial Hospital, Rochester, New York, by Alden H. Miller; Ralph F. Mocine, 2341 Cove Ave., Los Angeles, California, by Donald McLain; Susanne W. McLean, Harwood Court, Claremont, California, Ken W. Stott, Jr., 1724 Guizot, San Diego, California, and Florence V. Rhudy, 3543 Castle Reach, Riverside, California, by Willis E. Pequegnat.

President Howard then introduced the speaker of the evening, Mr. Walter W. Bennett, formerly a member of the U. S. Biological Survey. Mr. Bennett presented motion pictures of bird life in western Nebraska and discussed many problems relative to the survival of wildlife in that area.

Adjourned.—IRWIN D. NOKES, *Secretary*.

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For Sale, Exchange and Want Column.—Each Cooper Club member is entitled to one advertising notice in any issue of *The Condor* free. Notices of over ten lines will be charged for at the rate of 15 cents per line. For this department, address JOHN McB. ROBERTSON, Buena Park, California.

FOR SALE OR EXCHANGE—Wilson Bulletin, 1923-1930; Bird-Lore, vols. 9, 10, 11, and 12, bound in two books, also 1913-1930, unbound. Want Auk, 1919-1924, inclusive; want Condor, 1915-1920. —J. L. SLOANAKER, 1117 Maxwell Ave., Spokane, Wash.

SALE OF PACIFIC COAST AVIFAUNAS—For the next sixty days we will sell the following Avifaunas at the prices quoted, postpaid anywhere. Here is a chance for libraries and individuals to complete their files: No. 7, Birds of the Pacific Slope of Southern California, by Willett, \$0.50; No. 8, A Systematic List of the Birds of California, by Grinnell, \$0.25; No. 9, The Birds of the Fresno District, by Tyler, \$0.50; No. 10, Distributional List of the Birds of Arizona, by Swarth, \$0.50; No. 11, A Distributional List of the Birds of California, by Grinnell, \$1.00; No. 12, Birds of the Southern California Coastal Islands, by Howell, \$0.50; No. 13, Second Ten-year Index to *The Condor*, by Pemberton, \$1.00; No. 14, The Birds of Montana, by Saunders, \$2.00; No. 15, Birds Recorded from the Santa Rita Mountains in Southern Arizona, by Bailey, \$0.50; No. 16, Bibliography of California Ornithology, by Grinnell, \$2.00; No. 17, A Distributional List of the Birds of British Columbia, by Brooks and Swarth, \$1.50; No. 18, Directory of the Bird-life of the San Francisco Bay Region, by Grinnell and Wythe, \$1.50; No. 19, Birds of the Portland Area, Oregon, by Jewett and Gabrielson, \$0.50; No. 20, Third Ten-year Index to *The Condor*, by Willett, \$2.00; No. 21, Revised List of the Birds of Southwestern California, by Willett, \$2.00; No. 22, Birds of Nunivak Island, Alaska, by Swarth, \$1.00; No. 23, The Birds of Nevada, by Linsdale, \$2.00; No. 24, The Birds of the Charleston Mountains, Nevada, by van Rossem, \$1.00; No. 25, The Natural History of Magpies, by Linsdale, \$2.50 unbound, \$3.00 bound; No. 26, Bibliography of California Ornithology, 3rd Installment, by Grinnell, \$2.00.—W. LEE CHAMBERS, Business Manager, 2068 Escarpa Drive, Eagle Rock, California.

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